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The **What's New** magazine

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More mpg from those new super-slippery oils

One maker claims nearly five-percent gas saving and less engine wear, too. PAGE 46

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PS READERS TALK BACK

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Hazardous old film

In "The Trouble with Nitrates" ["Through the Viewfinder," Feb.], you say: "Don't worry about your 16mm or 8mm or super 8 movie films. They, like 35mm movies since 1952, are 'safety films'..." But I have some 8mm movies that date back to 1934. Are these safety films or are they hazardous?

Benjamin R. Fisher, Pittsburgh, Pa.

Everett H. Ortner replies: "Standard 8 and 16mm movies are probably on safety—acetate—stock and not on potentially dangerous nitrate. To be sure, examine the edge and look for the words 'safety film.' If you can't find any positive indication, assume that the film is on nitrate stock. For a test, put a 1/4-inch sliver of film in a container of trichloroethylene and agitate it. If the film floats, it's safety film; if it sinks, it's nitrate. Super 8 film can be assumed to be safety film.

"Another reader wrote to ask me about 9mm movies dating from the 1920's. For these, assume the worst."

Reciprocating flywheel?

From David Scott's article, "Opposed-Piston Diesel" [Dec. '77], I quote: "Smooth operation is also provided by the inertia of the heavy swing beams. They absorb half the explosion force as they're accelerated to engine speed, then return this energy to the crankshaft on the following inward stroke when there would normally be no torque delivery. These masses act like a reciprocating flywheel..."

Absurd! There is no such thing as a reciprocating flywheel. At piston bottom dead center (BDC), the beams are instantaneously motionless. Thus they have no energy to give to the crankshaft on the inward stroke.

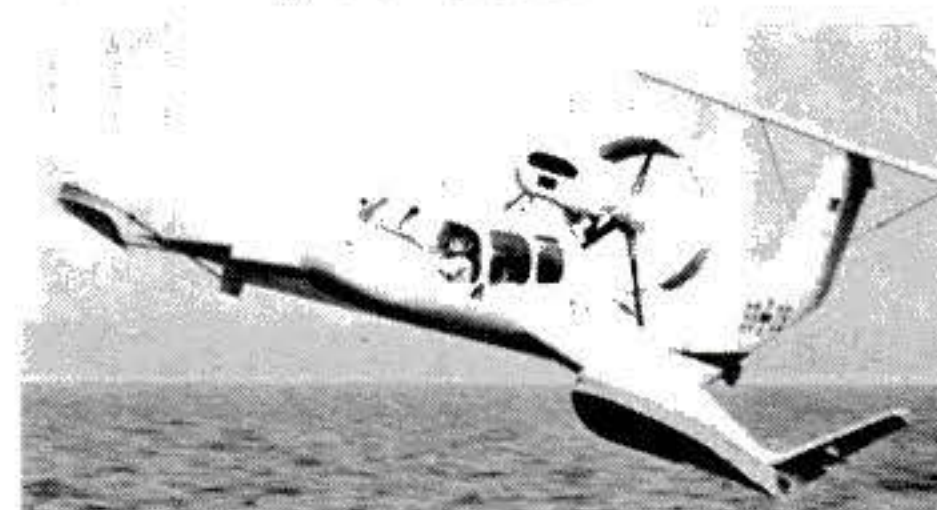
W. L. Coleman, South Londonderry, Vt.

David Scott replies: "It's true that the rockers do not store energy when they have stopped. But with no inertia of parts, an engine would need a vast flywheel to restrain piston acceleration after combustion. As this inertia of

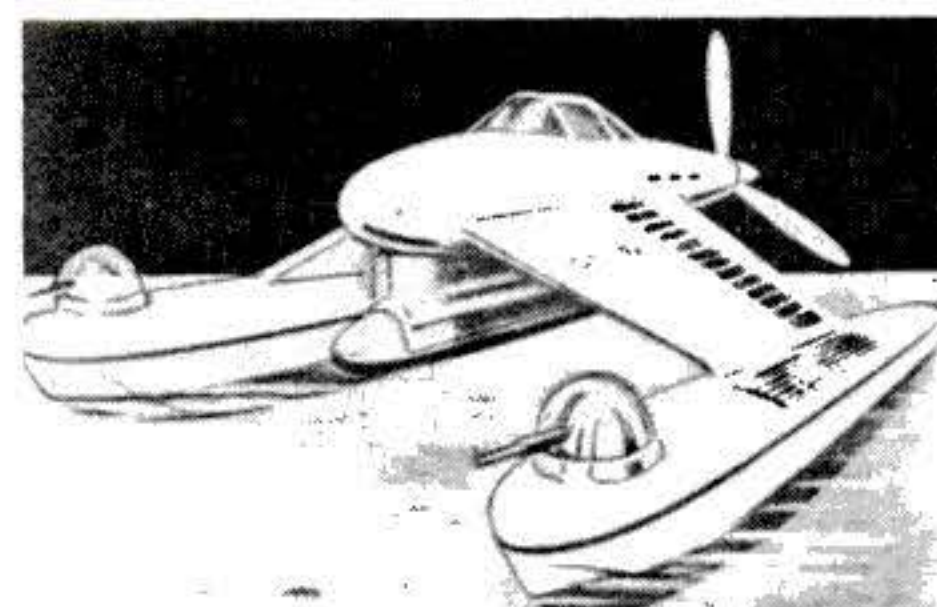
parts is increased, the flywheel size can be reduced for the same cyclic variation.

"Here you can have a small flywheel because the mass of the rockers absorbs some of the energy from expansion. On the return stroke this mass adds to flywheel inertia, so the drop in rotational speed during compression is minimized. The phrase 'act like a reciprocating flywheel' is merely for a quick mind's-eye picture of what is taking place."

Ram-wing's ancestor?



The ram-wing aircraft story [Dec. '77] by Ben Kocivar was very interesting and superbly written. But was the X-114 an original or copied design?



This picture shows a similar "Aerodynamic Torpedo Boat" designed by Alexander Tremulis in 1943 at Wright Field, Ohio. It was fun to compare the two designs.

James J. Bohash, Taylor, Mich.

"Leaked" heat may be useful

Mr. Trefil's article "Upping Insulation" [Feb.] overlooked one very important fact: The "leaking" heat from a hot-

[Continued on page 186]

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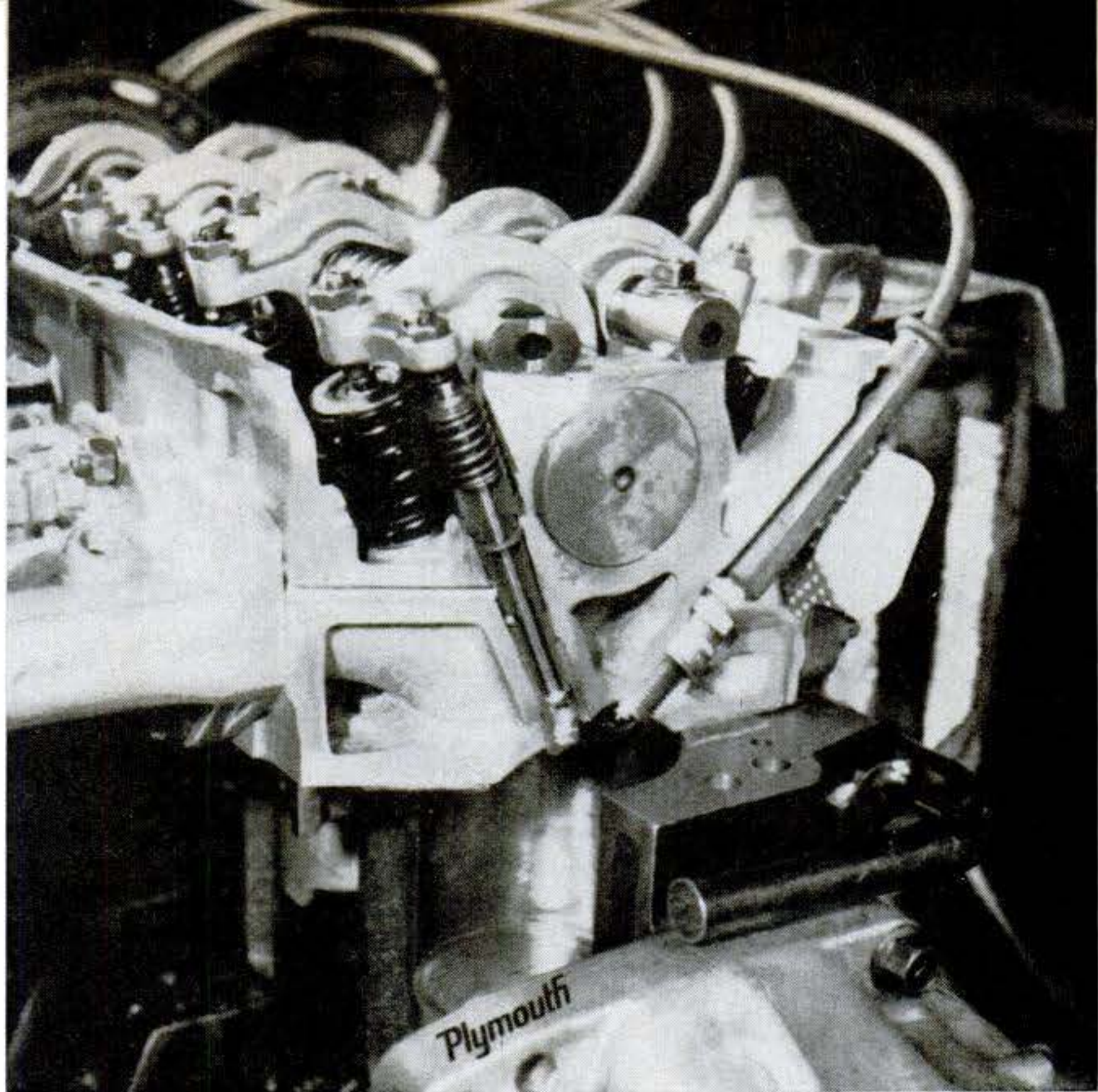
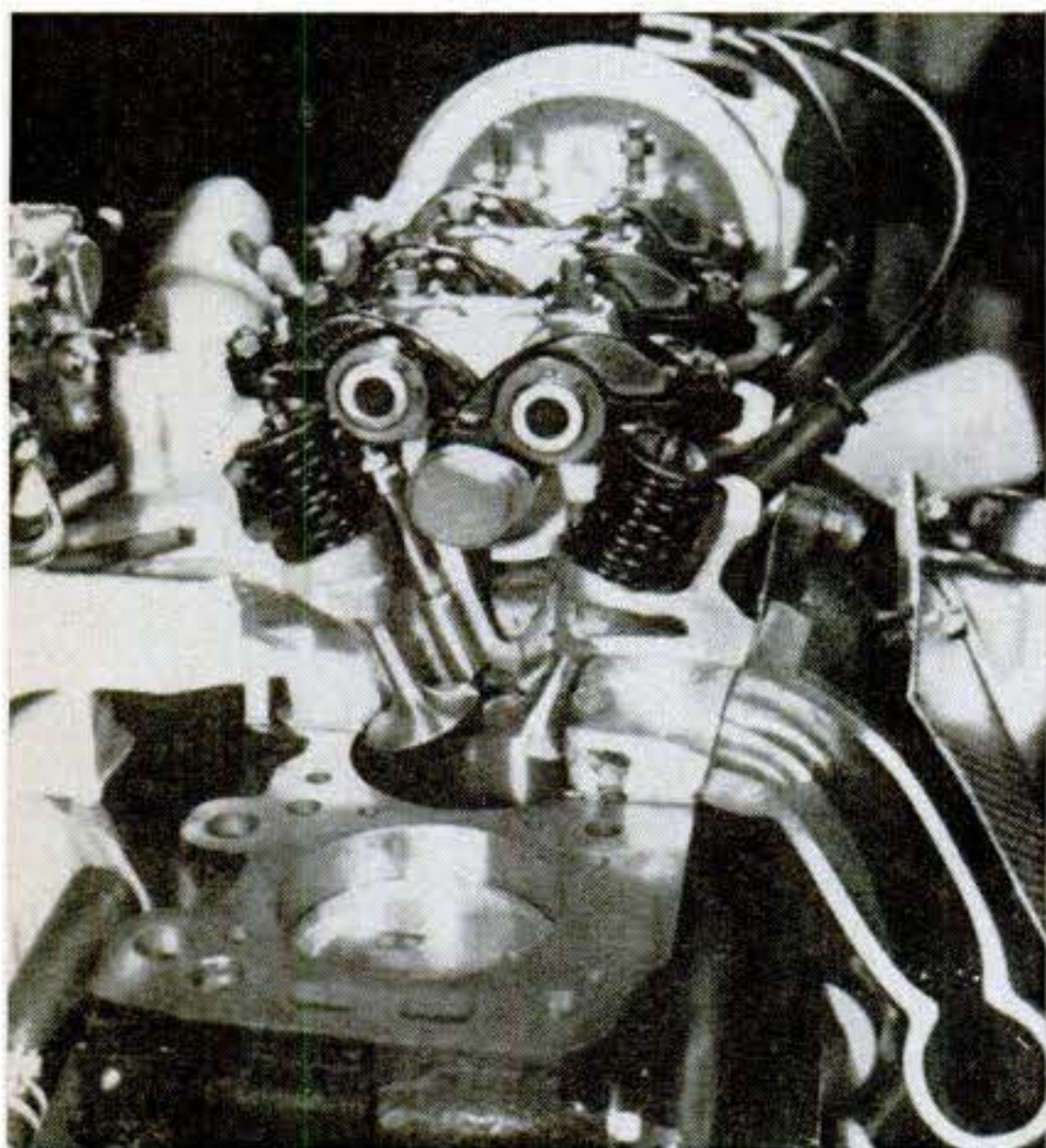
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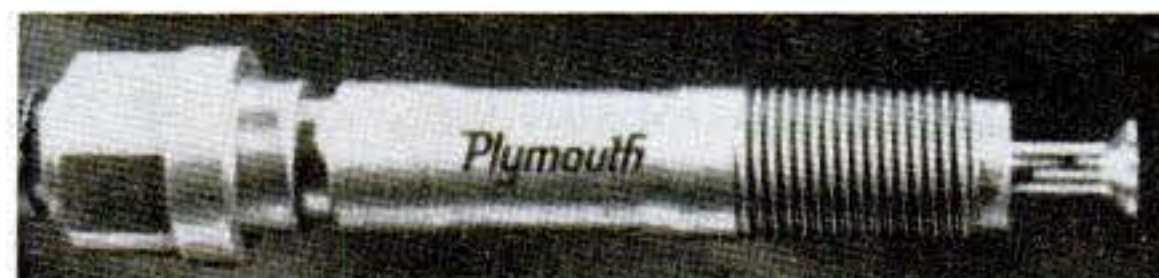


Mitsubishi's three-valve engine

—one way to reduce
emissions



Unique jet valve sits next to conventional intake valve (left) and opposite spark plug (above). The extra valve's job? To improve combustion efficiency by swirling a shot of lean fuel mix into the combustion chamber.



Tiny jet orifice at the tip of the jet valve makes the extra fuel/air mix shoot out at high speeds.

By JOHN M. HARTIGAN

To meet the challenge of tougher emissions standards, Chrysler has introduced a wallet-soothing innovation from Japan—the Mitsubishi Clean Air (MCA) Jet engine. By improving combustion, the new engine both cleans up exhaust and gives a claimed extra three to five mpg.

During combustion in a conventional engine, the flame front rushes away from the spark plug in a cone-shaped arc. But the advancing flame doesn't always expand evenly throughout the combustion chamber, and often fails to ignite some fuel. This happens especially at low engine speeds when there's less turbulence in the combustion chamber and the explosive mix isn't thoroughly blended.

Unburned fuel in the exhaust is a major cause of air pollution. It also fouls spark plugs and combustion chambers.

To solve these problems designers of the MCA Jet engine put an extra intake valve on each cylinder head. At low speeds, the valve shoots a high-speed jet of almost pure air into the combustion chamber, stir-

ring up the mix so it burns faster and more efficiently.

In action, the engine works much like a conventional one. The same rocker arm operates both the regular intake valve and the jet valve. Both valves get air conventionally, through the carburetor throat. And both valves depend on the descending piston to create a vacuum so fuel can flow through them. But what comes in through the extra valve depends on the position of the throttle. At idle, the tiny valve admits a shot of pure air into the combustion chamber. At low speeds, it shoots in a super-lean mix of fuel and air. At high speeds, when the throttle is fully open, it admits the same mix that's entering through the regular intake valve.

At high speeds, therefore, the extra valve has little effect—it slightly increases the amount of fuel/air mix sucked into the combustion chamber. But when the car slows down, fuel flow through the conventional intake valve is restricted by the closing throttle plate. Now the extra valve has a real impact, shooting an extra-lean gas/air mix into the combustion chamber. This lean mix swirls

around at right angles to the fuel still entering through the regular valve. The turbulence means that more of the fuel/air mix meets—and is ignited by—the advancing flame front. So less unburned fuel is passed into the exhaust. As a bonus, the swirling fuel also cleans combustion residue from the spark plug.

The MCA Jet engine is standard on all four-cylinder 1.6-, 2.0-, and 2.6-liter engines used in Plymouth Arrows and Sapporos, and Dodge Colts and Challengers.

The engine's fuel economy bettered by three to five mpg a conventional 1.6-liter engine in combined city/highway driving. When modified for California emissions standards, the MCA Jet 1.6-liter got four to nine mpg more than a conventional 1.6-liter engine with the same modifications.

The new Chrysler engines still need an exhaust-system catalyst to meet federal emission standards. They also need unleaded fuel. But improvements such as the MCA system should lessen the harmful effects of the internal-combustion engine while a more efficient power plant is being developed. **PS**

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Seamless roll-on roofing

By GREG STONE

"It's like putting a big, plastic umbrella on your house," said Dr. Breuning, obviously pleased with the day's effort.

We were standing on the roof of his suburban Massachusetts home. Half of it was still covered by conventional shingles; the other half had two-inch-thick blocks of Styrofoam insulation nailed to it.

These were being covered by a new, gray roofing material unlike any I'd ever seen.

The flexible PVC fiberglass-impregnated sheeting is called Sarnafil—after the Swiss town, Sarnen, where it's been manufactured since 1964. Just 1.2 millimeters thick, it comes in rolls two meters wide. The membrane can be glued with a special adhesive onto insulation or the structural deck, or it can be

weighted down with a conventional ballast. The same material is used for flashing, and all seams are quickly welded together with a hot-air gun. This makes Sarnafil essentially seamless and eliminates the loose edges that cause most roofing problems—particularly on flat or low-pitched shingle roofs. Wind can't lift and ice can't creep underneath the Sarnafil membrane.

Sarnafil is aimed at the big jobs, especially flat-top buildings or unusual architecture involving complex curves; it's been used on hotels, apartments, and other large buildings. Sarnafil U.S., Inc., recently introduced the roofing in Canada and New England and will go national, but it's selling only to professionals trained in its use.

The job usually costs between \$1.25 and \$2.50 a square foot—"about twice as expensive as a good grade of shingles," says Stanley Warshaw, president of Sarnafil U.S. (Box 381, Needham, Mass. 02192). Labor costs are lower, however, because application is relatively quick and easy.

Dr. Breuning chose Sarnafil for his home because he had two special problems: a roof with a very gentle slope that was being damaged each winter by ice; and an exposed cathedral ceiling that was pretty to look at but a pain in the checkbook when the heating and air-conditioning bills arrived. Adding insulation on the inside would have ruined the effect, so he decided to nail Styrofoam to the existing roofing and cover that with Sarnafil.

This is the type of installation where Sarnafil really shines, says Warshaw. You don't have the problems and expense of removing the old roofing, and you can handily add on insulation under the Sarnafil blanket.

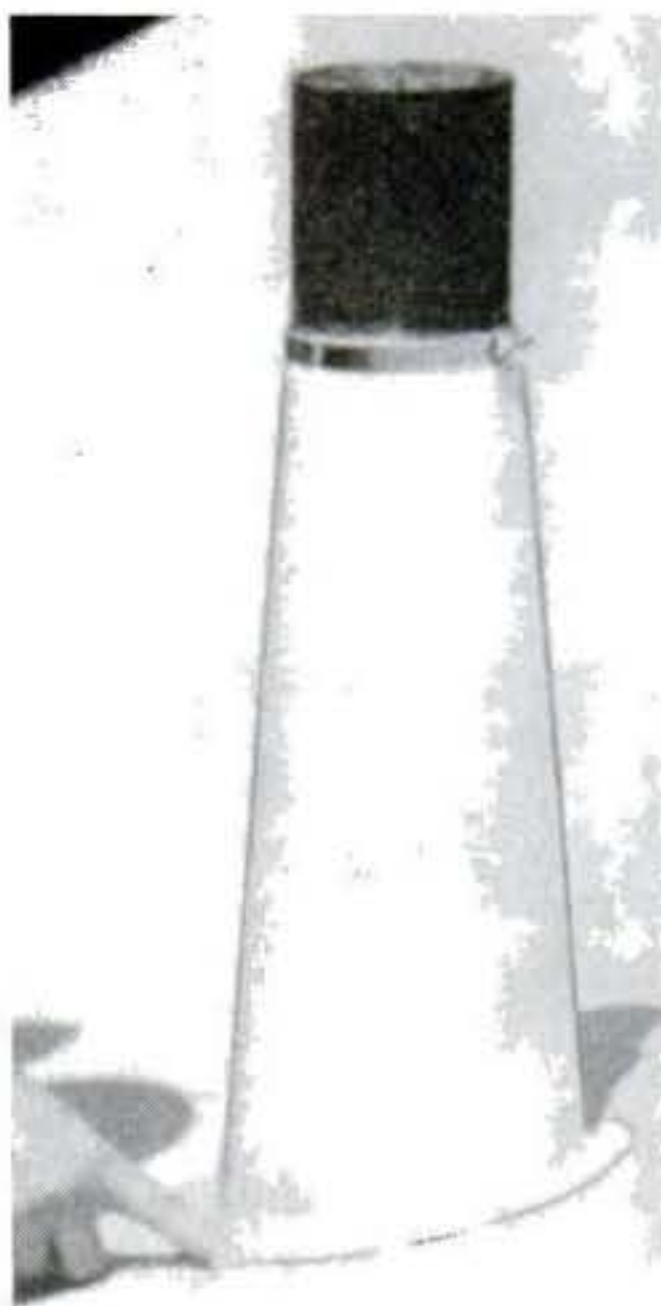
Sarnafil has been used from Norway to Uganda, and has proven resistant to all kinds of environmental assaults. It's permeable to water vapor, and allows humidity from the building to pass through—instead of trapping it and damaging the insulation, as conventional roofing can do. Sarnafil won't shrink after installation, but it's extensible enough to absorb movement caused by temperature fluctuations of the building.

The roofing will be sold in quantities small enough for home applications, says Warshaw. You could lay exterior insulation yourself and then have a contractor roll on the Sarnafil. It's guaranteed for 10 years.

PS



Workmen lay first sheet of Sarnafil roofing over Styrofoam insulation covering the original shingles on Breuning home. They've brushed special adhesive on Styrofoam and Sarnafil; they'll weld all seams with hot-air gun. The thin, flexible roofing is also used as flashing; it fits snugly on chimney (below) and vent pipe (right). Sarnametal—metal coated with Sarnafil—will be placed along edges of roof. Membrane's seamless effect gives ice and wind no chance to attack loose edges.



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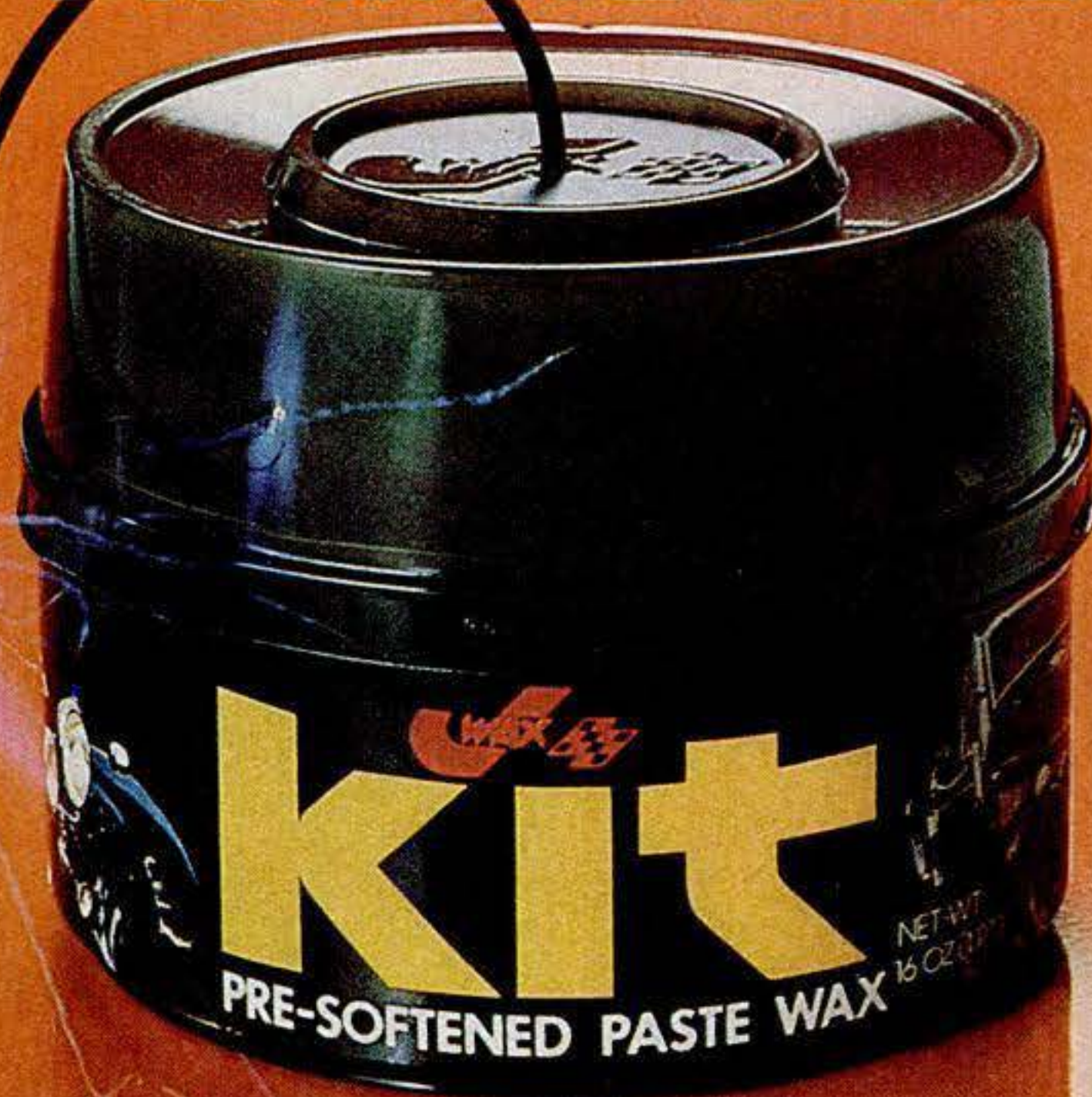
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Sawmill waste becomes clean-burning fuel pellets

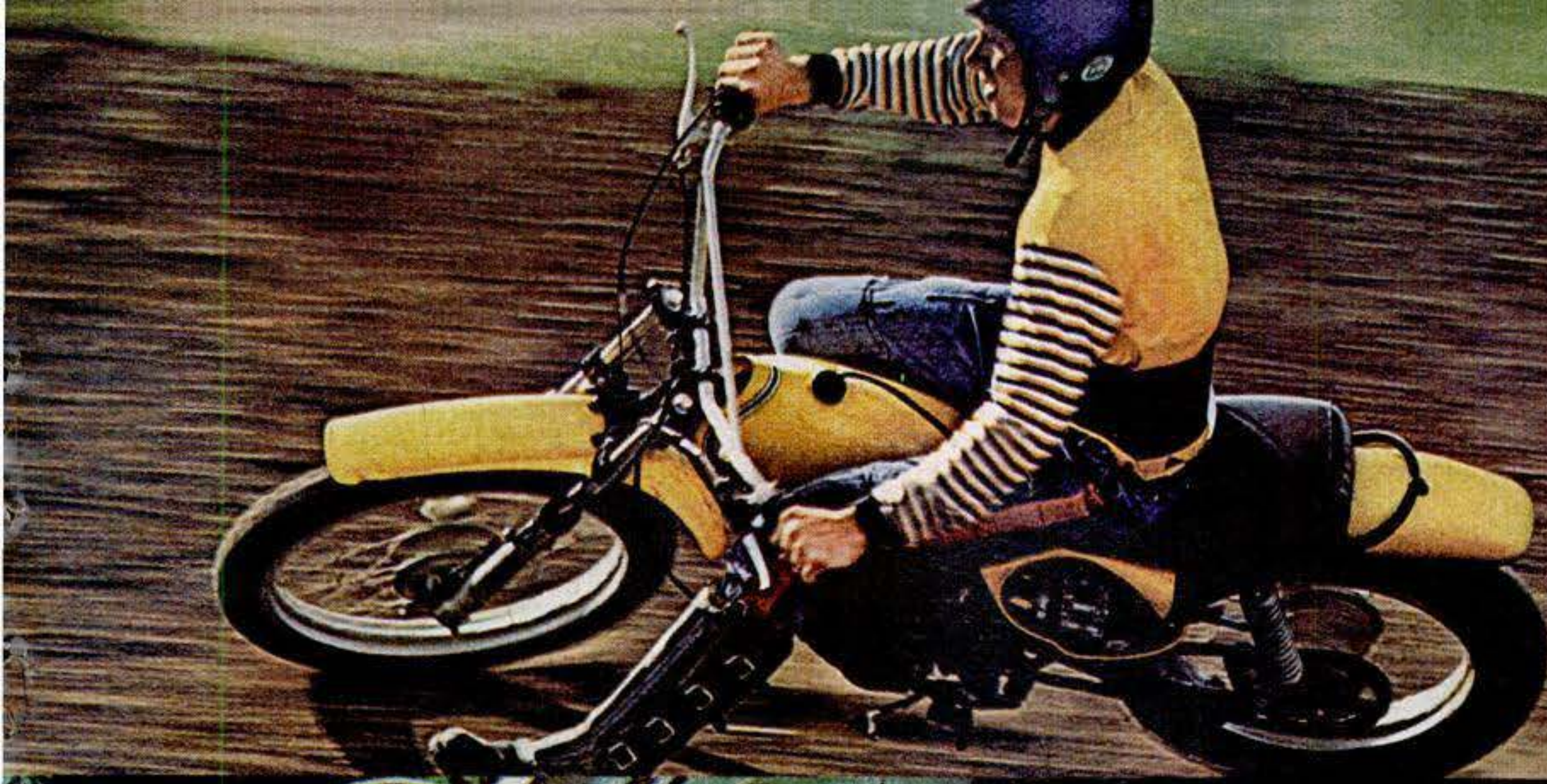
In a time when supplies of fossil fuels are diminishing rapidly, the Woodex, Inc., pellet plant in Brownsville, Ore., is producing a new fuel, made from organic fibers, that may be better than fuels that took natural forces millions of years to create.

Woodex pellets have three important advantages over conventional fuels. The first is economic: Enough of the fuel to yield one million Btu costs about \$1.10—roughly half the price of natural gas on the West Coast. Also the pellets are cleaner-burning than fossil fuels. According to the National Bureau of Standards, a pound of pellets generates 9000 Btu, like coal, but emits no sulfur, just 0.03 percent nitrogen, and leaves only two percent ash, whereas coal leaves 13 percent.

Pellets can be made from almost any fibrous organic matter. At present, Woodex is converting sawmill waste—bark, woodchips, and sawdust—but tests of straw, peat moss, coconut husks, and sugarcane fiber prove that pellets could be produced worldwide.

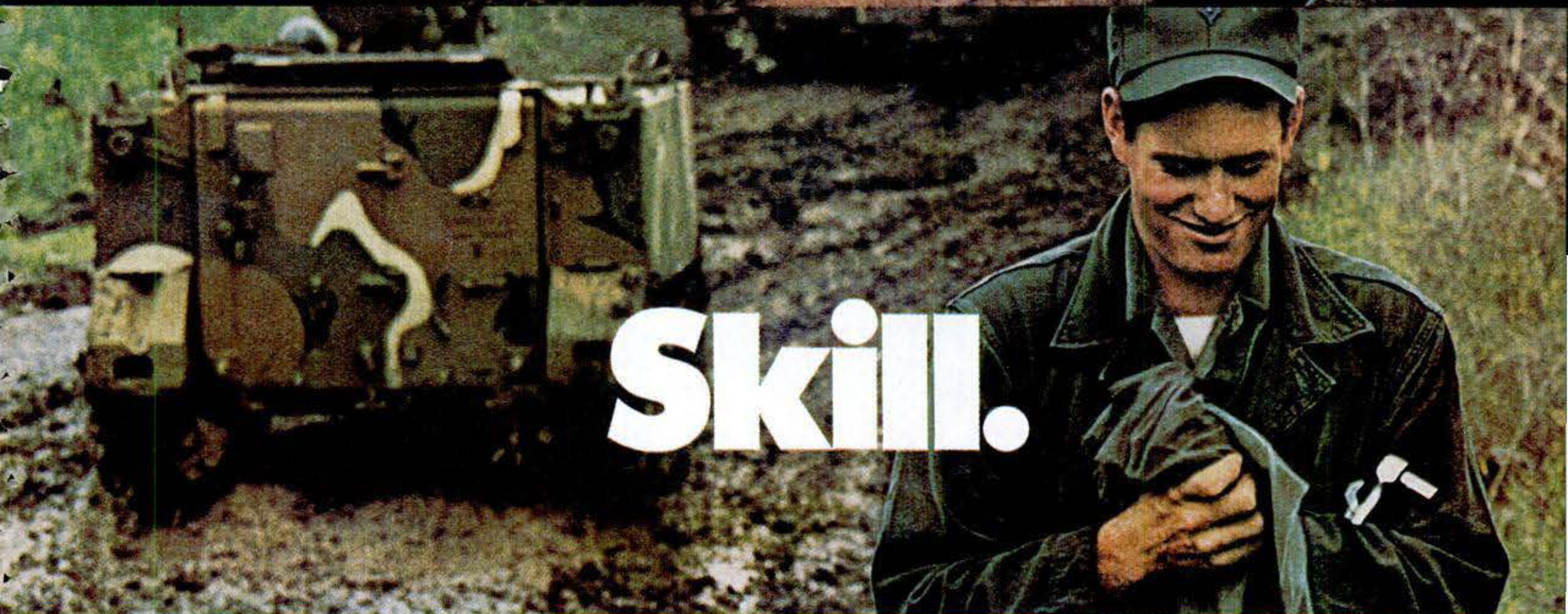
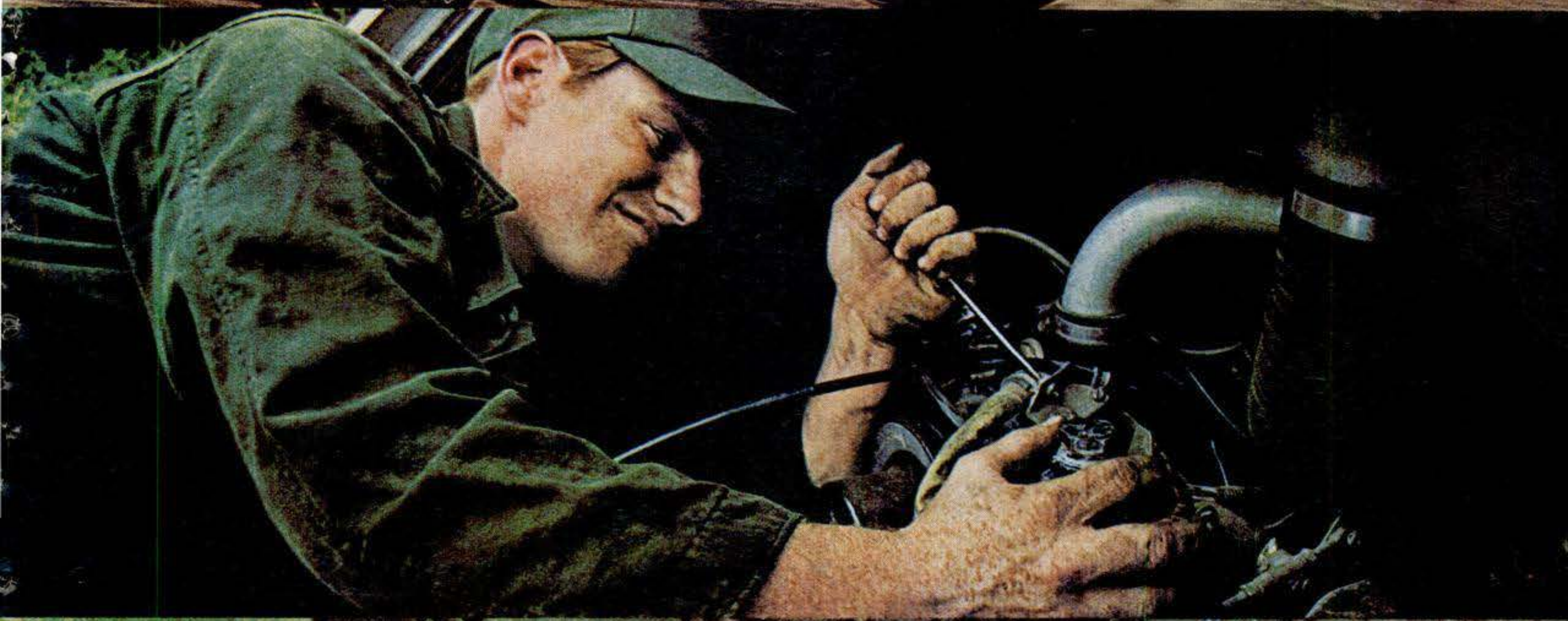
Manufacturing the pellets is a three-step procedure. Raw material (upper right in photo) is first pulverized by a hammermill and then blown through a dryer. Next, the powder (center) is forced through a perforated steel drum to form pellets (upper left). Bound together by natural resins, the pellets are 1/4" in diameter and 3/4" long.

Institutions using pellets report good results. Western State Hospital in Ft. Steilacoom, Wash., uses 50 tons of them daily. They expect to save \$60,000 in heating costs plus \$200,000 in air-pollution control equipment this year.—Gerald Wing



Pay & Benefits

If you enlist in the Army, you'll start with good pay; a long list of skill-training courses to choose from; 30 days paid vacation each year; the opportunities to travel and to continue your education. For more information about all the opportunities in today's Army, send the postcard.



Skill.

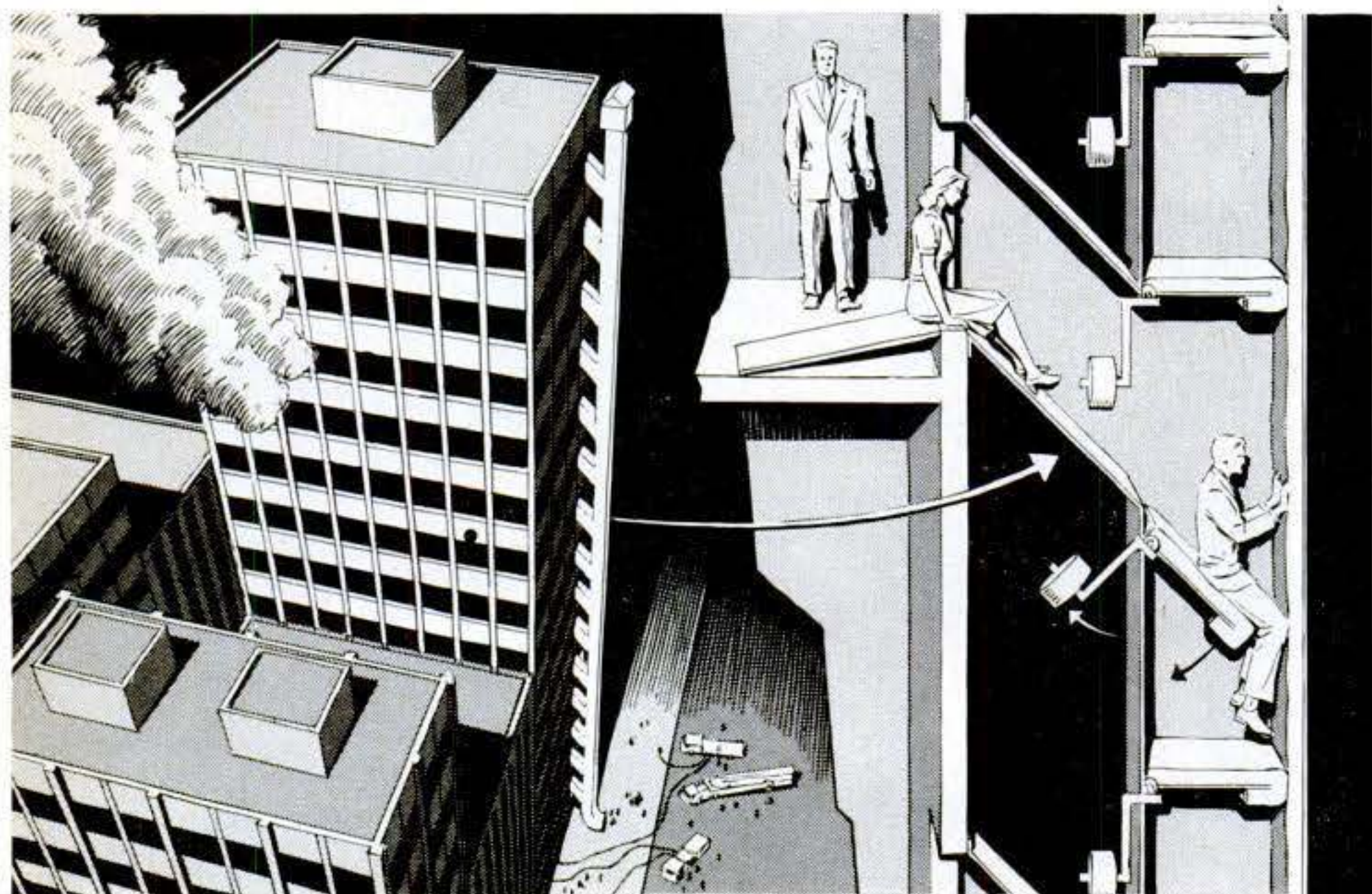
"A skill is the art of knowing what you're doing. I always liked to tinker with things, rebuild engines, work on my bike. When I joined the Army, I became an Automotive Repairman. Here's the first place I ever saw a Detroit diesel — or had good tools. In the Army, you have to work on all different things. You're expected to think for yourself a lot, but there's always somebody there to help you. They teach you to get your skill down pat, no doubts in your mind. Dad called the other night. He'd like me to work on his car."

SP4 Jim Meinzer, Ft. Riley, Kansas

**Join the people
who've joined the Army.**

NEW IDEAS FROM THE INVENTORS

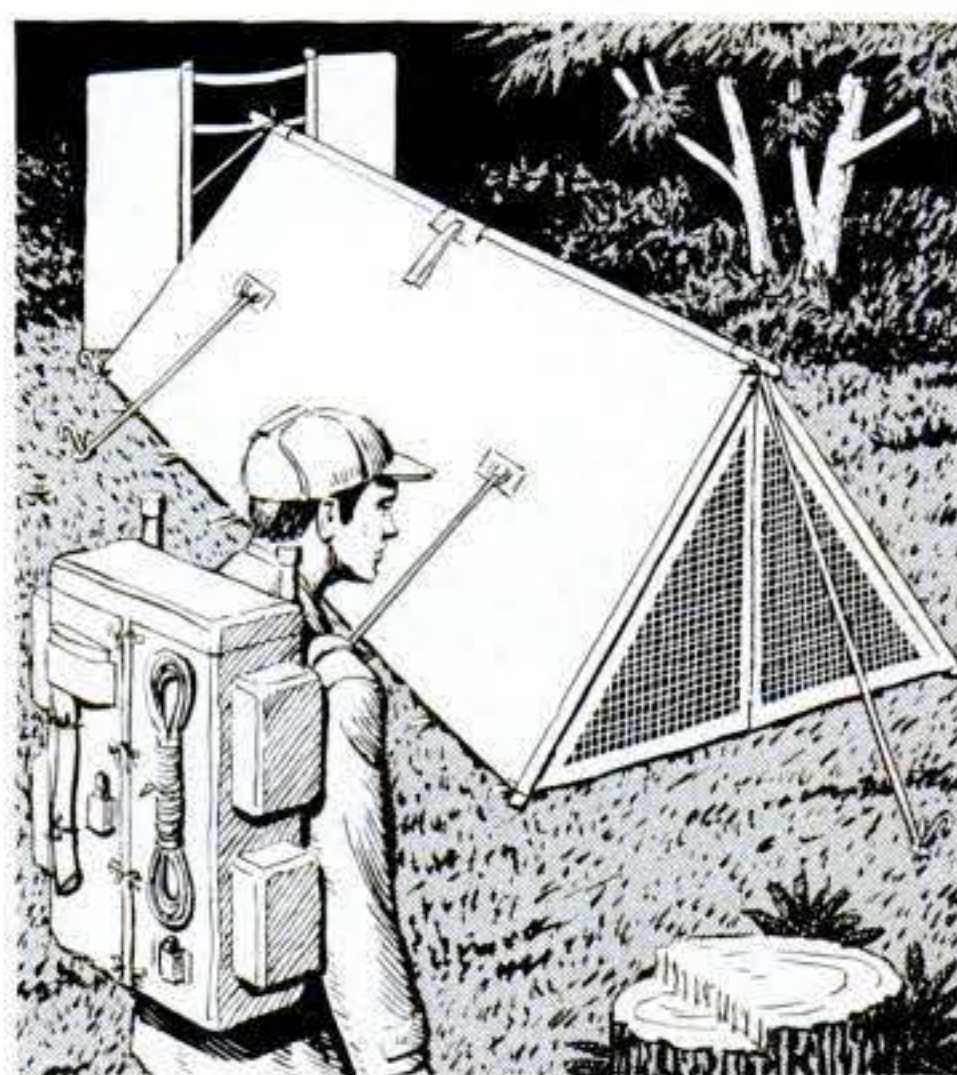
ILLUSTRATIONS BY RAY PIOCH



Outside chute speeds building evacuation

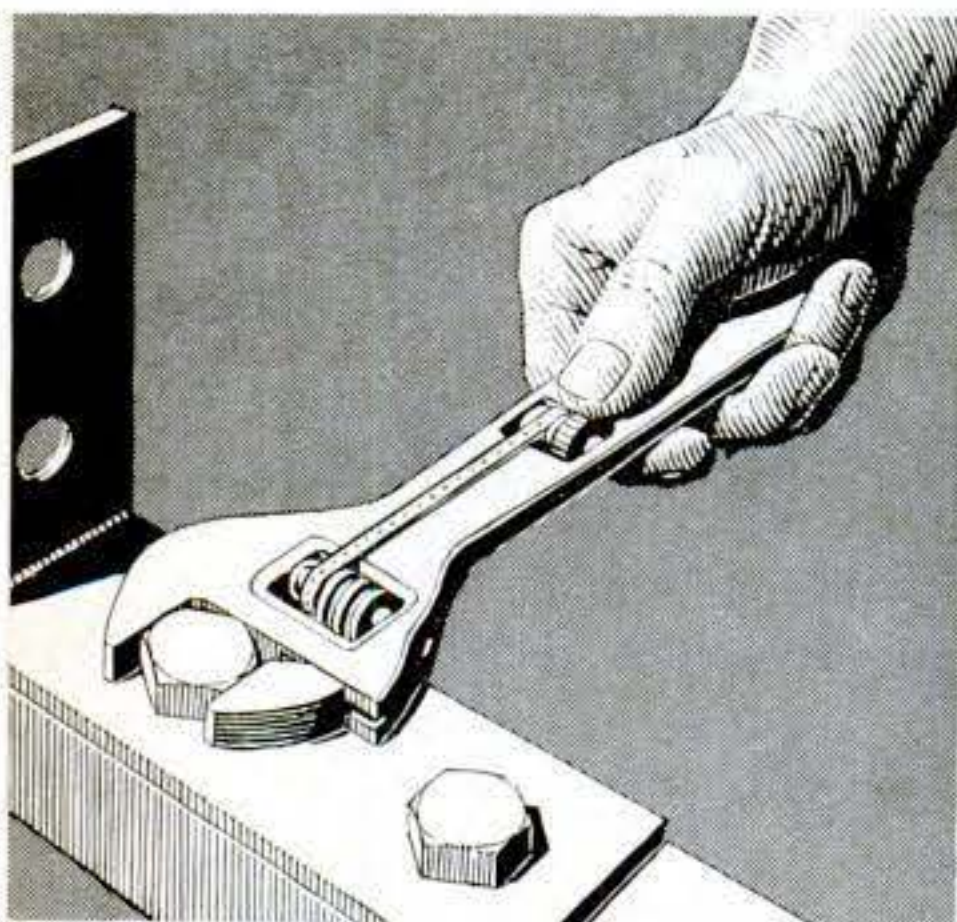
Pivoted, counterweighted platforms in this emergency chute would help to speed evacuation of people trapped by fire on an upper floor of a high-rise building. Designed to attach to—and blend with—existing structures, the

chute would be accessible through a door on each landing. To escape to the ground or a fire-free lower floor, a tenant would sit on a platform. His weight would tip it, lowering him gently. Interlocks would regulate floor-to-floor traffic.



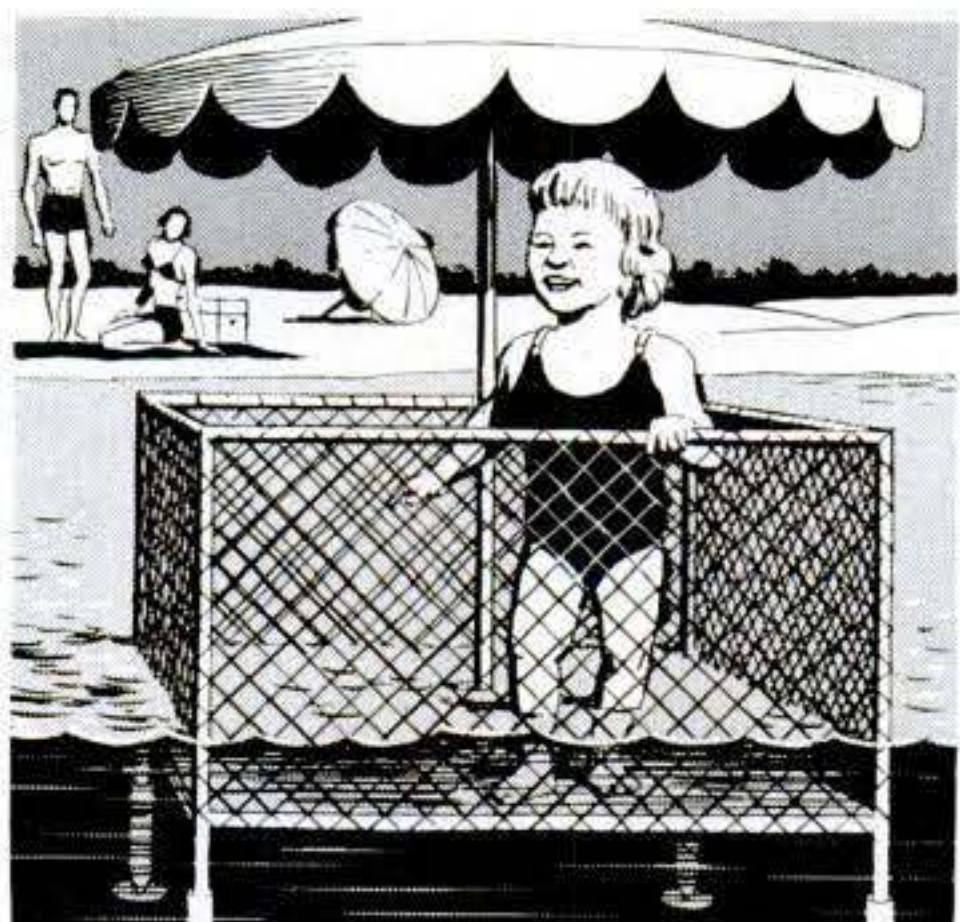
Backpack tent stows gear

Specially formed flaps and pockets in this tent cover would stow food, clothing, and selected outdoor items and would serve also to stiffen the cover when it was folded onto its metal backpack frame. When set up as a frame-supported tent over its self-contained mat, the pockets would be protected from weather while the frame bow straps doubled as tie-downs.



Handle pulley adjusts wrench

Hard-to-reach nuts might not be quite so hard to reach if you tackled them with a wrench like this. The thumb pulley set high on the handle would be connected to the worm-gear jaw adjustment by a perforated, flexible belt. It would let you loosen or tighten the jaw setting even in places too snug for both the wrench and your fingers.



Water pen protects kids

Set down in a pool or lake or stream, this water-safe playpen could be leveled on separately adjustable legs and bottomed to a safe height for temporarily untended toddlers. Collapsible for storage and transport, it would travel easily to the waterside and let grown-ups go about their business or pleasure without worrying about the kids.



Panic stop deflates tires

Auxiliary valves around the insides of these tire-equipped wheels would be pressed on driver command by a free-wheeling deflector plate to let air out of matched pairs of tires when a collision seemed imminent. Flattening the tires partway would increase road-gripping surface and might provide just enough extra traction to prevent a disaster.

The following patents have been issued on these inventions: **Escape chute**—No. 4,037,685 to A. Talucci, Syracuse, N.Y.; **Thumb wrench**—No. 4,028,970 to S. Pelczar, East Hartford, Conn.; **Water playpen**—No. 3,874,005 to K. Badon, Lake Charles, La.; **Backpack tent**—No. 3,931,918 to G. Smith, Bedminster, N.J., and J. Marshall, Bel Air, Md.; **Emergen-**

cy tire deflator—No. 3,871,471 to W. Wong, Honolulu, Hawaii. Copies of patents may be ordered, by number, from the Commissioner of Patents and Trademarks, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if address above is insufficient, address him by name and patent number in care of the Commissioner.

Oldsmobile wagons work like wagons. With the quality ride you expect from Oldsmobile.

Custom Cruiser: full-sized for families who need room and want even more luxury.

The full-sized Olds Custom Cruiser has plenty of loading room inside, practical dimensions outside, and comfort all around plus the luxury you'd expect to find in a full-size Oldsmobile. With a ride that's all Oldsmobile, smooth, solid, serene. And you can expect good fuel efficiency, too. EPA estimates are 22 highway, 15 city and 17 combined with standard 350 V-8 and automatic transmission*. (Estimates are lower in California.)

Cutlass Cruiser: for young, growing families on a budget.

Now you can discover that great Cutlass Feeling in a wagon. Cutlass Cruiser is a whole new size that looks and feels like a Cutlass, but loads and carries like a wagon. And it has a short turning radius, a new chassis and suspension and a quality Oldsmobile ride. And good gas mileage, too. EPA mileage estimates are 25 highway, 18 city, 21 combined with available 260 V-8 and automatic transmission*. The best V-8 EPA gas mileage ratings of any mid-size wagon! (Engine not available in California.)

Test drive the Custom Cruiser and the new Cutlass Cruiser at your Olds dealer's, and discover the working wagons with the quality Oldsmobile ride.

*Your mileage depends on how and where you drive, your car's condition and equipment. Cutlass Cruisers are equipped with GM engines produced by various divisions. See your dealer for details.

Oldsmobile

Can we build one for you?



Cutlass Cruiser

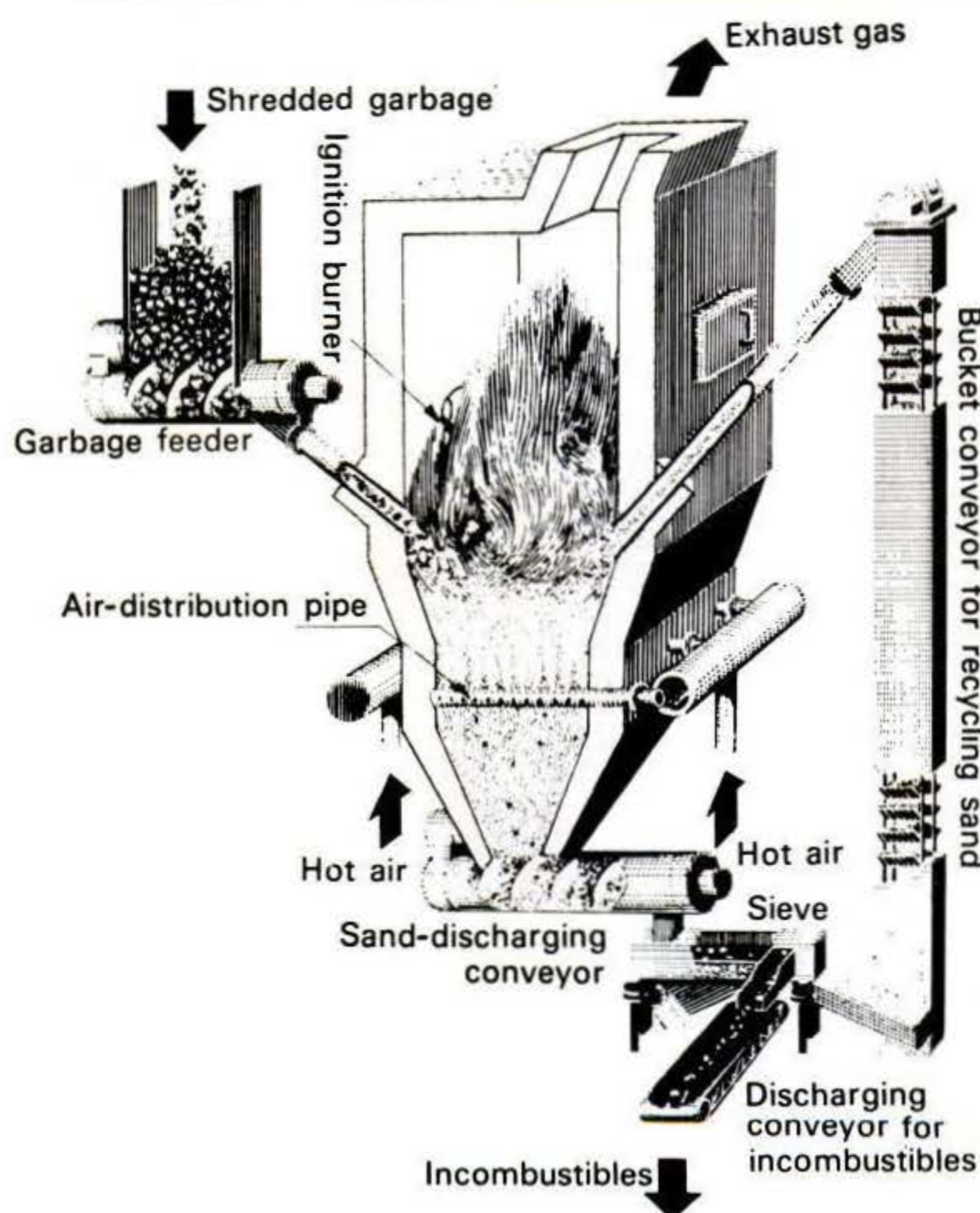
Custom Cruiser

There's a lot of News in Olds today.



SCIENCE NEWSFRONT

By ARTHUR FISHER



Garbage incinerator

Does your city have garbage-disposal problems? It might be interested in this Japanese fluidized-bed incinerator with a capacity of 120 tons each 24 hours that was recently installed near Tokyo. The fluidized-bed approach floats the material to be burned on a cushion of air and relies on a fine granular medium—such as sand—to keep the material in a semi-fluid condition. The aim is to improve combustion by giving air access to the largest possible surface area of garbage. One of the problems with fluidized-bed incinerators, however, is that the incombustible residue from the garbage collects at the bottom and fouls up the bed.

The new design, developed by IHI, Japan, uses pipes instead of a flat plate to distribute air. Thus sand and incombustibles can be blown down between the pipes, later to be extracted from the bottom and separated. The sand is recycled; the incombustibles are discharged.

The designer claims the new in-

cinerator greatly reduces air pollution because combustion is complete; that all kinds of refuse, including sewage, sludge, waste oil, and shavings, are reduced to small dry sanitary cinders; and that these are suitable for land reclamation because they contain very low levels of heavy metals.

Fitsatcom

That stands for Fleet Satellite Communication, a new worldwide system that will serve the critical communications needs of the U.S. Navy, Air Force, Department of Defense, and the Presidential Command Network. The first spacecraft in the network was launched and placed in orbit in February.

In the photo below you see a model being tested at its builder's, TRW Defense and Space Systems Group. The satellite has an eight-foot hexagonal body with a 16-foot deployable parabolic UHF antenna for transmitting and a helical UHF antenna for receiving, which you can see mounted on the edge of the dish. Panels of solar cells provide more than 1400 watts of electricity.

Two more of the geosynchronous satellites are now scheduled for launch. Each satellite will provide 23 operating channels. The system will eventually serve small mobile users virtually anywhere in the world. The exception: the regions very close to the poles, which will be covered by other satellites.

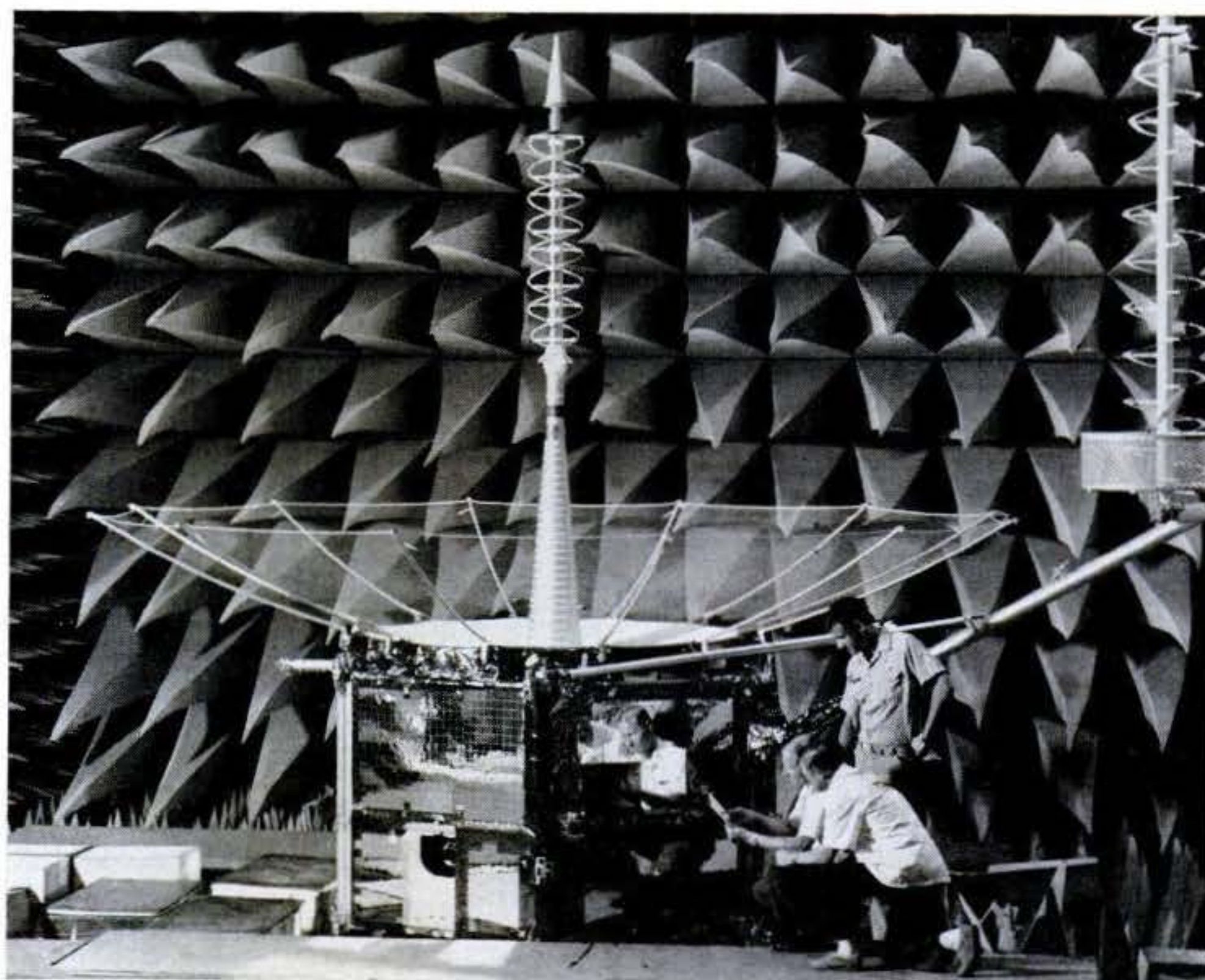
New lightweight steel

You may never have heard of "duplex ferrite-martensite" but you're likely to in future. It's a fibrous material that is a vital component in a new steel alloy, developed by engineers at the University of California's Lawrence Berkeley Laboratory (LBL). The high-strength, formable, lightweight steel should be useful in fabricating autos that are lighter for fuel economy, yet structurally as strong as vehicles built with conventional steel alloys.

Is nothing sacred?

Delectable, tantalizing, elusive. . . . That's the truffle, object of every true gastronome's desire. And, one might add, shockingly expensive: about \$200 for 14 ounces in the U.S.—canned, no less. That's because the truffle—a fungus-like plant—is not only the subject of gourmet greed, but is not a domesticated crop: It can be found only near certain species of trees growing in certain soils in France and Italy. And

Continued



Don't tell me taste isn't everything.

I expect one thing from my cigarette.
Taste. And only Winston gives me the taste
I like. Winston is all taste all the time.
And for me, taste is everything.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.



Winston King. Winston 100's.

COLEMAN® INFLATE-ALL™ 150

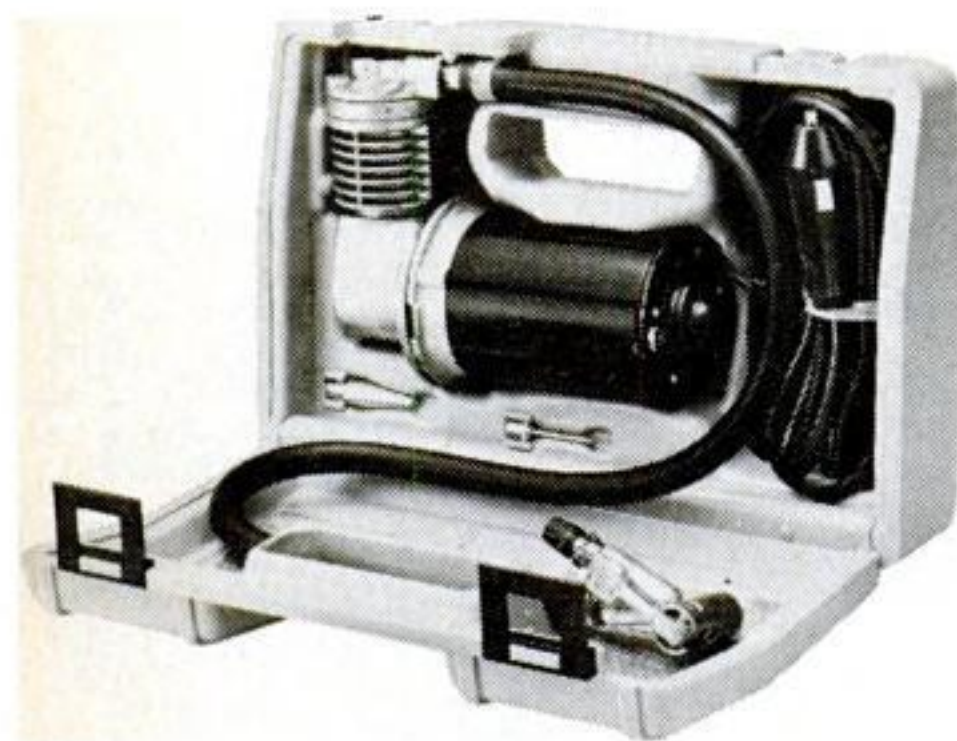


No air? No sweat!

Operates from 12-v auto cigarette lighter... pumps up to 150 p.s.i.

For passenger tires... FWD, pickup and RV tires... motorcycle and bike tires... air shocks... footballs, basketballs, volleyballs... dozens of other uses.

And it's the one with Coleman quality. So you know you can count on it in the clutch.



The Coleman Company, Inc.
Wichita, Kansas 67201

NOW IN LEADING AUTOMOTIVE DEPARTMENTS

Science newsfront

[Continued]

because truffles grow underground, they can be detected only by highly trained animals—truffle hounds and pigs which pick up the ineffable aroma. Men have tried and failed to cultivate the truffle since Roman times.

But wait! Can it be? A bulletin from the French National Institute for Agronomic Research at Clermont-Ferrand has announced that, by inoculating the roots of trees with mashed truffles, scientists have succeeded in growing and harvesting 20 truffles weighing a total of one kilo. It took 3½ years to cultivate the truffles, as opposed to the six years or so that they are thought to take to mature in nature.

Separating the chaff

Deceiving enemy radar to protect one's own aircraft, a part of that black art called ECM (electronic countermeasures), has long relied on a plane's dispersing the metallized fibers known as chaff. The chaff forms a cloud that bounces back radar signals and produces a confusing image on the enemy radarscope to help mask the actual location of the plane. But current methods of dispersing chaff, claim engineers at Calspan Corp. in Buffalo, N.Y., are inefficient; the fibers clump together, resulting in a radar reflection that is only 5-10 percent effective.

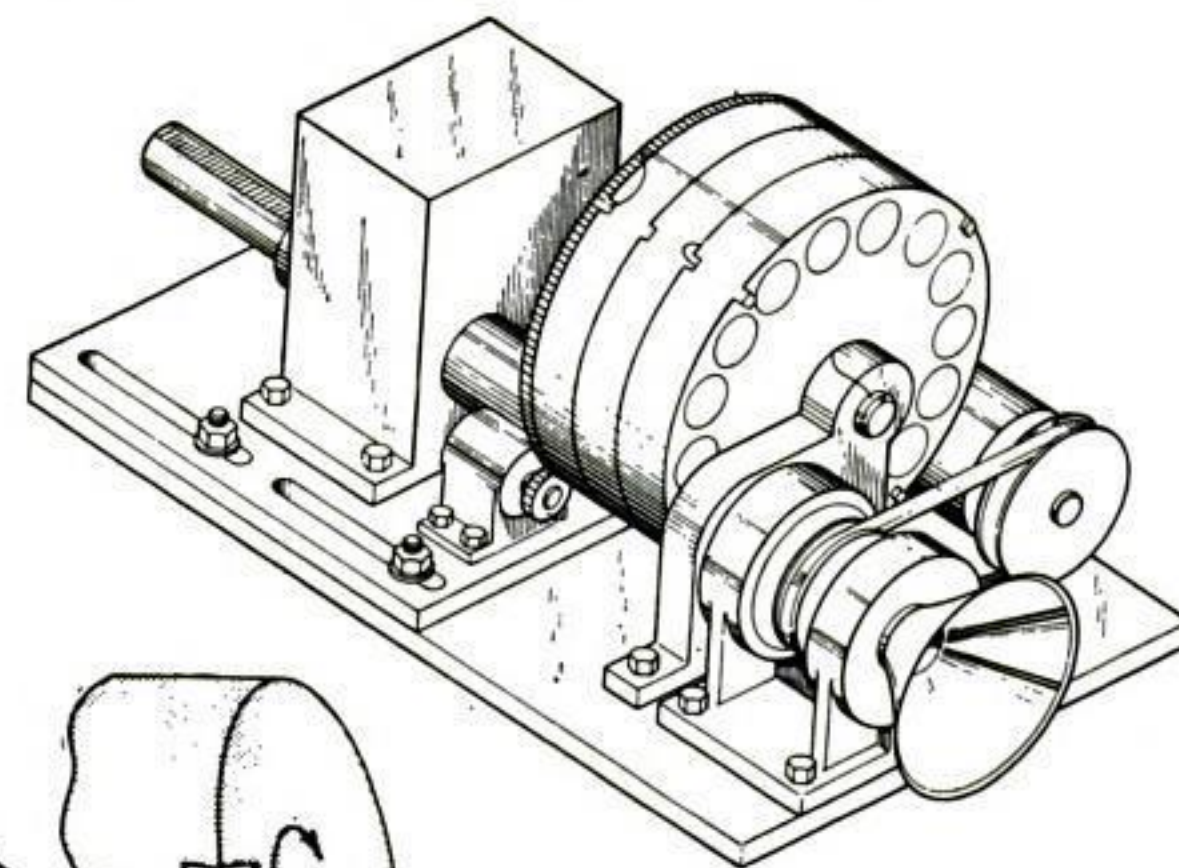
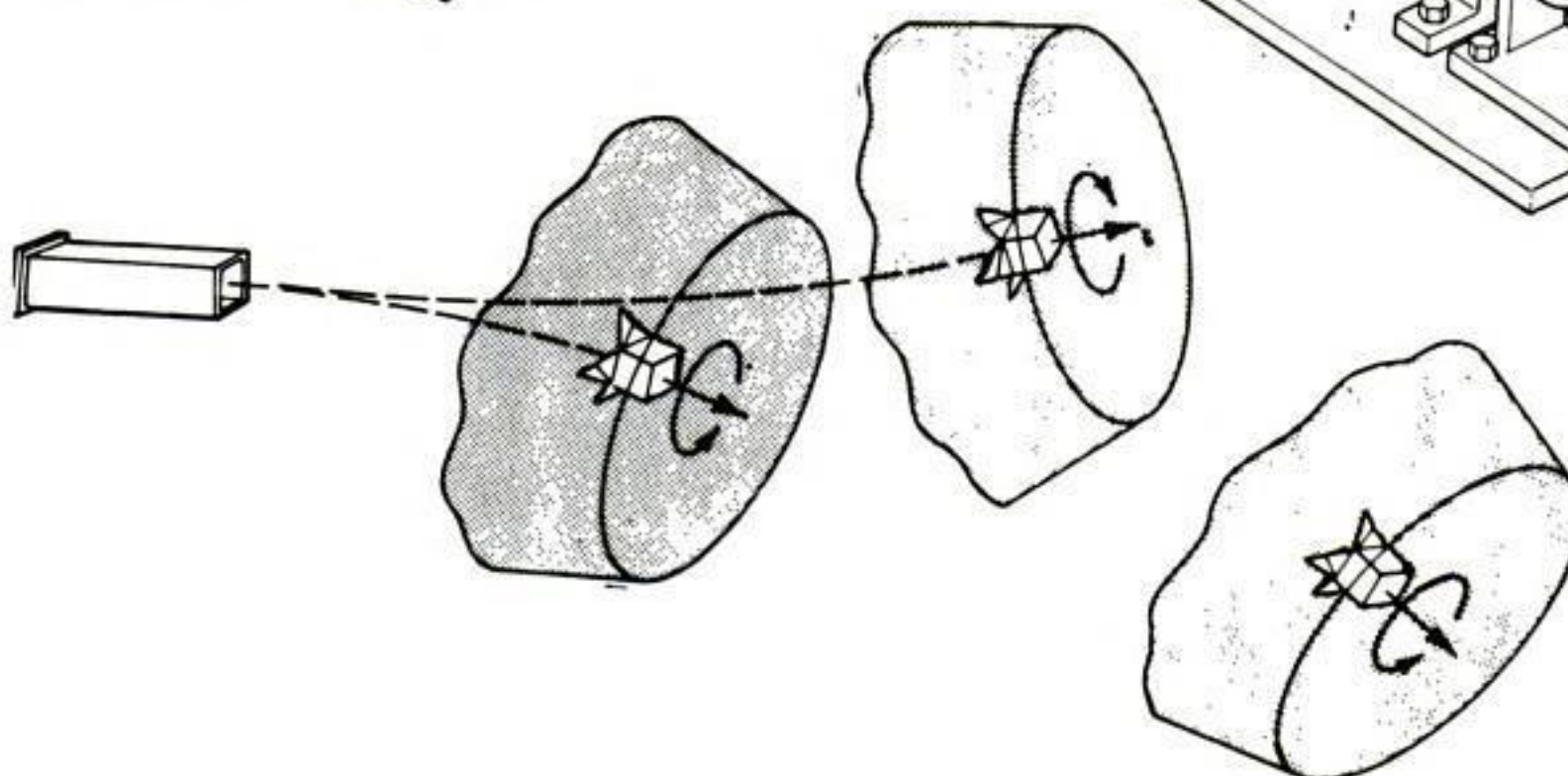
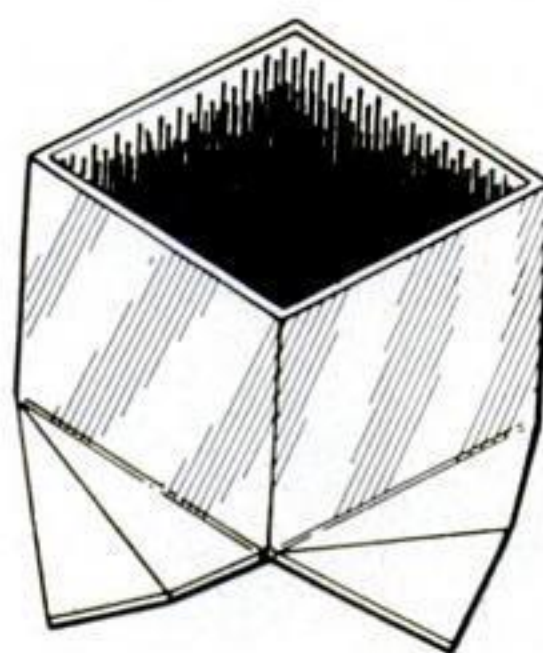
The sketches below show two different ways the Calspan people have devised to enhance the confusing radar image. At top left is a capsule, filled with metallized fibers, to be fired from a chaff cartridge. Before firing, the fins are folded. After firing, they unfold and spin the capsule up or down, as in the bottom drawing; the capsule's spin separates the chaff widely. The second method—a centrifugal dispenser—is shown at top right. Chaff from packets in the drum pass through a rapidly ro-



tating chamber, flaring out as they leave the funnel-shaped nozzle.

Superconducting generator

Scientists at General Electric's Research and Development Center report progress on the superpowerful, superconducting electric generator they will have ready for testing by 1979. The device is designed to generate 20 million volt-amperes of alternating current when its 2500-pound, 10-foot-long rotor, seen in the photo, spins at 3600 rpm. The rotor will be chilled by liquid helium to -452° F, a mere seven degrees above absolute zero. At this temperature, electrical resistance in the generator's windings drops to near zero, with a resulting large increase in efficiency. The machine should produce as much power as generators twice its size. The largest conventional generators—1200 to 1500 MVA—are almost too large for railroads to handle. **PS**



Telephone Answering Breakthrough

Let a new remote control answering computer free you from your next telephone call.



The new Ford Code-A-Phone 1400 answering computer.

It's a telephone answering computer. The Ford Code-A-Phone 1400 has the first large-scale integration of solid-state componentry—a major change in telephone answering systems since the first mass consumer models appeared five years ago. This means more features, lower cost and greater dependability. Here are some of its exciting features:

Forget about tapes There are no tapes to buy. The Ford unit has a special polymer-based magnetic tape that will record over 25,000 phone calls without replacement. That's over five solid years of use. There are no cassette tapes to buy, wear out or replace.

Forget about microphones When you want to change or record your message, just press a red button, record your message and let go. The message (any length up to 20 seconds) will record and be immediately ready to playback since the message tape does not have to recycle. There are no separate microphones or level controls since the built-in microphone automatically adjusts to your voice.

Forget about touching it You can adjust your unit to answer on either one or four rings. When the unit is set on four rings and you reach the phone before the 1400 answers, you will not activate the unit. But let us say you're outside or indisposed. No problem. Code-A-Phone will automatically answer after four rings. This means that your unit can always be "alive" in the four-ring position so you never have to remember to set it whenever you leave your home or office.

Forget about going home Just bring your optional remote control pager with you. If you want your messages while you're on vacation or away, call your number and the coded pager will remotely signal your unit to playback all your messages.

Forget about service If you've owned a telephone answering device for more than a year, there's a good chance that it's been in for service at least once. The Code-A-Phone, however, is solid state and built with the same heavy duty components used in commercial units. It should dependably stand up to years of heavy usage. (Ford Industries is the world's largest supplier of telephone answering equipment for the Bell system.) If service is ever required, there are over 200 authorized service centers plus a service-by-mail center. There's also a toll-free "Help-Line" number to call 24 hours a day for advice or suggestions, and your unit has a limited ninety day parts and labor warranty.



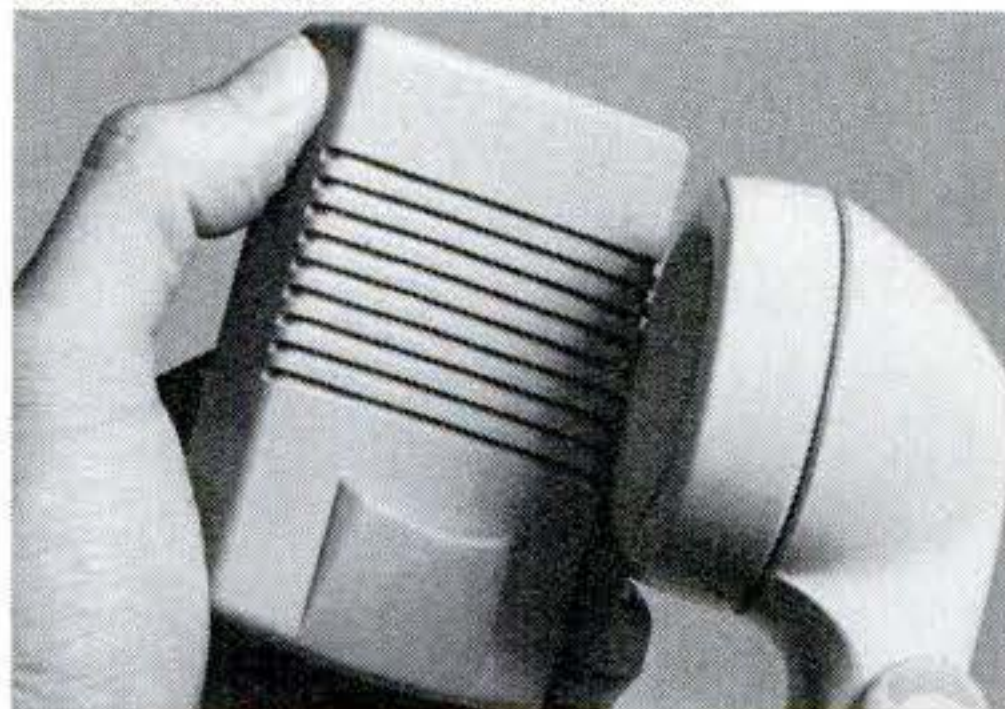
The entire printed circuit-board with its integrated circuits is easily replaceable and contains the "Brains" required to control the audio amplifier and tape transport system.

PLENTY MORE FEATURES

Code-A-Phone has a monitor feature—you can listen to the caller leave his message and pick up the phone to intercept the call. If you want to skip over a message on the tape, just tap a button and it fast-advances to the start of the next call. It has a selectable erase feature that lets you erase a specific message or the entire tape if you wish.

KNOW HOW MANY CALLS

With other answering machines, you never know how many calls you receive until you play them back. With Code-A-Phone you have a call counter—a device that displays the exact number of calls you've received when you arrive home. If you now own another answering machine, you can really appreciate this convenient and exclusive feature.



Hold the small pocket-sized remote-control pager up to any telephone in the world and you can playback all your messages.

Code-A-Phone is the first really versatile answerer that works equally well at home or in the office. It's perfect for the busy or working housewife who spends little time at home. And, if she's home and just plain busy when the phone rings, she can always call back later without offending the caller.

The executive can now leave his office, call from the field and get all his messages. An inefficient operator at a telephone answering service may offend your customers by putting them on hold. Code-A-Phone, however, takes your message quickly—without delay.

There are very few people who haven't left a message on a telephone answering machine, and callers really appreciate the convenience.

NO PHONE COMPANY TARIFFS

Code-A-Phone is equipped with an FCC-registered interconnect device so your unit is actually welcome on your phone line. The 1400 comes with a four-pronged plug so you just plug it into your phone jack. If you don't have a phone jack, just call your phone company and tell them you are purchasing an approved Code-A-Phone and that you want a four-pronged jack for your phone. They'll know exactly what you want and charge you around \$12 for the installation, depending on where you live. If you have a multi-line phone, they can install a jack to tie into any or all of the lines you wish. There are no additional monthly charges.

STANDING BEHIND A PRODUCT

JS&A lets you use the 1400 in your home or office for one full month. Use it to screen your calls, take messages while you're gone or as a back up system when you're busy. Use the remote pager and retrieve calls while you're out. See how easy it is to change the message in seconds, and see how much it uncomplicates your life. Use it under your everyday conditions at home or at your office and then decide after one month whether or not you want to keep it. If you decide to keep it, you'll own the best. If not, return your unit for a full and prompt refund. There is no risk. Even if you already own a phone answerer, it would pay for you to see how much better the Code-A-Phone performs.

JS&A is America's largest single source of space-age products and a substantial company—assurance that your purchase is protected.

The Code-A-Phone comes in two models: the Remote Control unit for \$249.95 called the 1400 and the same unit without the pager but with all the other features for \$169.95 called the 1200. Simply select the unit you want and send your check for the correct amount to the address shown below. Credit card buyers may phone in their orders by calling our toll-free number below. (Illinois residents add 5% sales tax.) **There are no postage and handling charges.**

By return mail, you'll receive a Code-A-Phone complete with all connections and instructions (extra pagers are available for remote unit) plus your ninety day limited parts and labor warranty. The unit measures 3 1/4" x 8 1/2" x 12" and weighs six pounds.

Code-A-Phone compares to units that sell for much more but do not have the simplicity and the advanced electronics. Don't be confused. Code-A-Phone is the finest telephone answerer you can buy at any price and is years ahead of all other conventional systems.

JS&A gives you everything you could possibly expect from a telephone answering system: 1) A unit years ahead of every other unit at a very reasonable price. 2) A service network that covers the United States with repair centers and free telephone assistance. 3) The chance to buy a unit in complete confidence, knowing that you may return it without being penalized with a postage and handling charge if it's not exactly what you want. You can't lose.

Computer technology has even touched the telephone answerer. Now is the best time to get the finest system available. Order your Code-A-Phone without obligation, today.

JS&A NATIONAL SALES GROUP

Dept. PS One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-9000

CALL TOLL-FREE... 800 323-6400
In Illinois call (312) 498-6900

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How to buy your first tractor.

It's easy to buy a tractor. You go to a dealer. Pay him some money. He gives you a tractor.

Buying the right tractor is another matter. It's not hard to do. But there are a couple of important things to keep in mind.

YOU DON'T EAT SOUP WITH A FORK.

And you don't need a 100 horsepower tractor to raise vegetables, move some dirt on your farm, or landscape your yard.

The prime consideration in buying your first tractor is to get the right tractor for the job you have to do.

KUBOTA. THE MID-SIZE TRACTOR.

We are the world's leading manufacturer of mid-size tractors. In fact, that's all we make. We don't make giant tractors. Nor do we make garden toys. Kubota covers the ground in between. So we're just right for your lesser jobs that still require the power and versatility of a real tractor. So even if you already own a 400 acre spread and a couple of heavyweight tractors, you probably still have a place for a mid-size Kubota.

If you don't want to lavish a lot of attention on your tractor, Kubota's a good one for you.

All Kubotas have water-cooled diesel engines. Diesel engines have no electric ignition system, and they never require a tune-up. This means service is reduced to a bare minimum. Which brings us to another of our strong suits. Economy.

HOW TO SAVE MONEY.

Running a Kubota diesel engine costs a lot less than what it would cost to run a comparable gasoline engine. And a 12 to 47.5 horsepower Kubota is going to burn up a lot less fuel than a larger machine.

Your Kubota dealer is the right man to tell you which Kubota suits your needs best. Which Kubota implements you should have. And whether you need a 2- or 4-wheel drive.

Then there's only one thing left to do. Take our tractor and put it to work.

We're looking for work.

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PS5



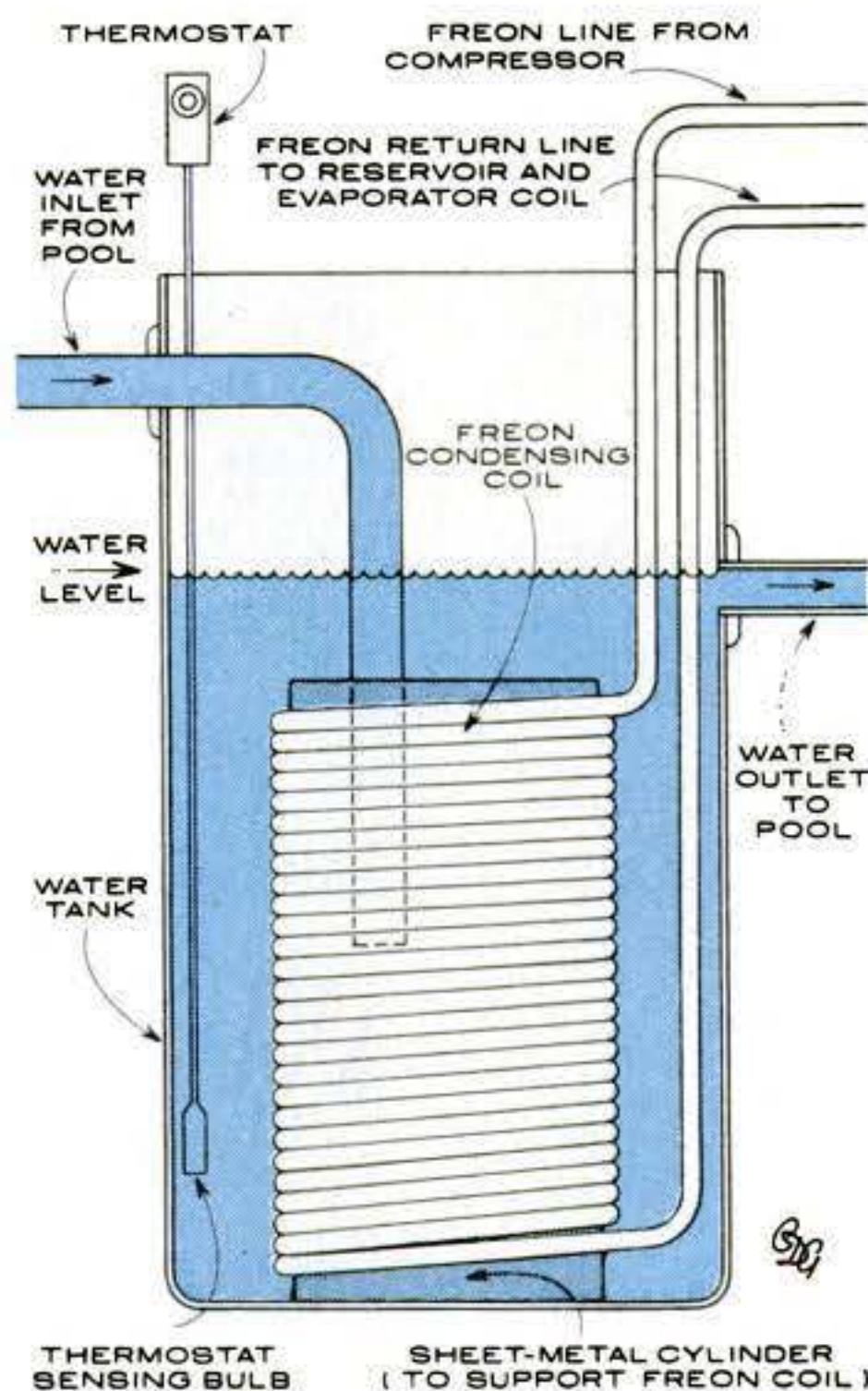
ADVENTURES IN ALTERNATE ENERGY

A monthly sampling of projects PS readers have devised to conserve or replace fossil fuels

Eli S. Chesen,

Freon condenser

cools house, heats pool



Freon condensing coil consists of 200 feet of copper tubing wrapped around a sheet-metal cylinder submerged in a 50-gallon water tank (above). Freon under compression gives off heat to surrounding water. In photo at left, Chesen removes lid from water tank. Pool water enters tank through upper pipe, leaves through lower pipe.

By EDWARD MORAN

When Dr. Eli Chesen enjoys a swim in his backyard pool, he feels even better knowing that the warm water in his pool is helping to air-condition his house and that his air conditioner is helping to heat his pool.

Last year, Chesen linked his pool's plumbing to the compressor and Freon reservoir of his central air-conditioning system. Heat from the house is thus dumped into the pool instead of into the atmosphere—a water-cooled rather than air-cooled Freon-condensing system.

In a conventional air conditioner, a fan cools vaporized Freon in the condenser coil, returning it to liquid state. Then liquid Freon is piped to the evaporator coil where it vaporizes, absorbing heat from indoor air. The vaporized refrigerant then flows to the compressor and on to the condenser coil to repeat the cycle. Chesen has simply replaced the condenser coil with a coil of copper tubing submerged in a tank of water, in effect producing a swimming-pool-assisted air conditioner.

Commercially available components are used throughout, putting the system within the reach of most

do-it-yourselfers. Chesen spent about \$150 in materials; the only other major expense was hiring a professional to charge the Freon lines. "It functions beautifully," he says. He estimates a saving of about 20 percent in fuel bills for cooling his 2700-sq.-ft. home and heating his 288-sq.-ft. pool, so the pay-back period is quite reasonable.

The system (see drawing) consists of a plastic 50-gallon water tank with a submerged copper-clad sheet-metal cylinder supporting 200 feet of coiled copper tubing. The cylinder also serves as a heat-exchange surface: As the Freon liquefies, it heats the copper tubing and transfers heat to the water in the 50-gallon tank. The Freon coils are connected to the high-pressure side of the air-conditioning compressor and the evaporator coils, respectively. Pool water is pumped into the tank via 1½" polyvinyl-chloride pipe; it enters through the upper pipe and returns to the pool through the pipe at right in the drawing.

When the air conditioner is running and the water in the tank has been heated to 105 degrees (an empirical figure arrived at through trial and error), a submersible thermostat actuates a relay that turns on the swimming-pool pump, circulating pool water around the warm copper tubing. Chesen uses a Honeywell T675A 1540 remote-bulb temperature controller—though substitutes are possible—to turn on the pump should it not be running at the moment when the air conditioner is functioning. A switch permits the system to be operated manually, independently of the air-conditioning system. And a clock-operated switch can be used if automatic pool-filtering cycles are desired.

Performance

When the system went into operation in May 1976 Chesen was able to raise his pool temperature from 56 degrees to 84 degrees in 60 hours, a level that was easy to maintain for the rest of the swimming season. "It may sound like overkill to run the air-conditioning system from mid-May," he says, "but the extra \$20 or \$30 spent was more than made up for during the swimming season."

Chesen feels his system has commercial possibilities, and has a patent pending on the device. To ask a specific question, send a stamped, return envelope to Dr. Eli S. Chesen, 3531 Cooper Ave., Lincoln, Neb. 68506. **PS**



New Chevy Nova.

At \$3702*, it's a steal.

The new Chevy Nova Coupe's price is almost too good to be true. Because Nova's one of those rare cars that keeps its own special appeal year after year: A great combination of quality and value.

Police Nova: proven in 47 states.

Police departments all across the country have tested and applauded specially equipped Novas for their durability, reliability and overall rugged performance. They've made it the best-selling police compact in America.

Now the same people who build the Police Nova build a Nova for you. And they both have strong reputations.

16 years of experience.

Chevy Nova's a veteran. It's been dependably pleasing people for 16 years. There's been a lot of improvement along the way, and a remarkable four million sold.

Easy on gas. 26 MPG hwy. 19 MPG city.

Nova, with its standard 250 Cu. In. 6-cylinder engine and manual transmission, achieved those EPA estimates. Manual transmission not available in California, where estimates are 21 mpg highway, 15 city, with available automatic transmission. Your mileage depends on how and where you drive, your car's condition and

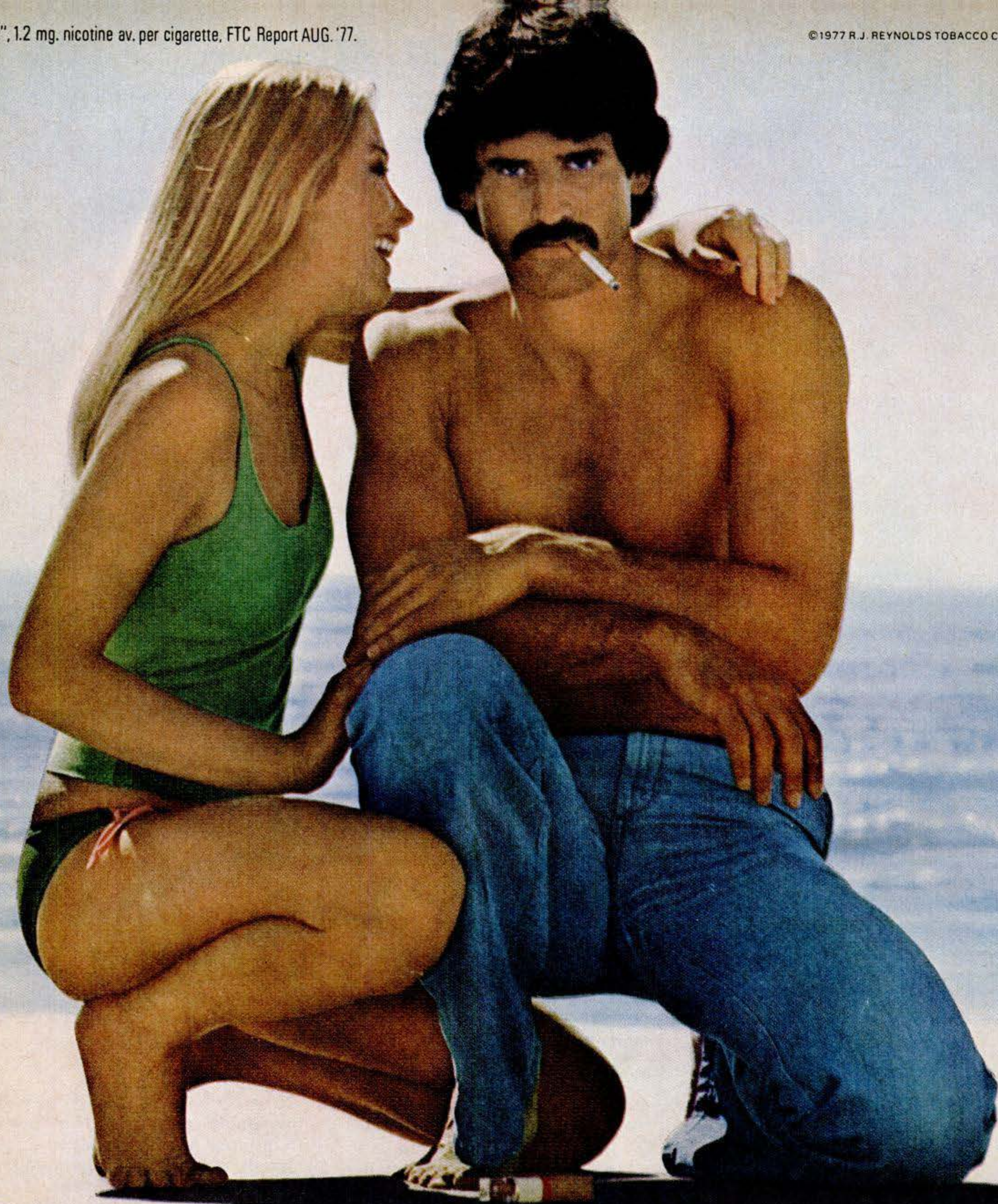
available equipment. The Nova is equipped with GM-built engines produced by various divisions. See your dealer for details.

Chevy Nova. A wanted car.

*Manufacturer's suggested retail price for Nova Coupe, including dealer preparation. Available full wheel covers (\$37) and white stripe tires (\$36) shown. Tax, license, destination charges and available equipment are additional. Priced higher in California.



**SEE WHAT'S NEW TODAY
IN A CHEVROLET.**



One of a kind.

Where others rush through life, he knows when to reflect. To enjoy. He smokes for pleasure and satisfaction. He gets both from the blend of Turkish and Domestic tobaccos in Camel Filters. Do you?

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

RECREATION ROUNDUP

By HERBERT SHULDINER



4WD vans

For venturesome outdoorsmen a new group of vehicles is becoming very popular: four-wheel-drive vans. An increasing number of manufacturers now offer these go-anywhere boxes-on-wheels. One of the newest is from Champion (top), which offers a 4WD conversion on Dodge/Plymouth 1/2-, 3/4-, and one-ton vans. The model shown here is a 3/4-ton Dodge B-200. It uses a Dana 44 FBJ front axle and New Process 203 full-time 4WD transfer case. You can order the Champion conversions through all Dodge or Plymouth dealers. Price range is \$8500-9300.

A new four-wheel-drive from Pathfinder Equipment Co. (bottom) is now available for the 109-inch wheelbase Dodge B-300 Van. It uses the same front axle and transfer case provided in Champion conversions. Overall length of the rig is 176 inches—shorter than the Blazer, Bronco, or Ram Charger. Price for the 4WD van shown here is about \$11,500 from Dodge dealers.

Portable shower

If you like to camp away from civilization, but still want to keep clean, the



new Porta-Shower (above) from Care-free of Colorado might fit your needs. It's well suited for RV's, vans, and pickups.

The Porta-Shower folds up into a 25-by-25-by-8-inch package and weighs 15 pounds. It sets up in minutes. The reservoir holds 5.4 gallons—enough for two showers. It costs \$179.95.

Sportsman's sunglasses

There's a new wrinkle in photochromic sunglasses. Recently introduced Amber-Matic lenses from Bausch & Lomb not

only adjust to changing light, but actually change colors in response to various weather conditions.

I've been testing a pair of these new Ray-Ban sunglasses for a few months and find them to be quite a help outdoors. In warm weather, the glasses are brown and provide efficient glare protection on beaches. During cold winter weather, the lenses turn a dark gray. When there's little sunlight—on overcast or hazy days—the lenses turn amber. This seems to add a little sparkle to outdoor scenes. The AmberMatics come in plastic or metal frames. Prices start at \$30. The metal-frames shown below are \$38.

Scientific expeditions

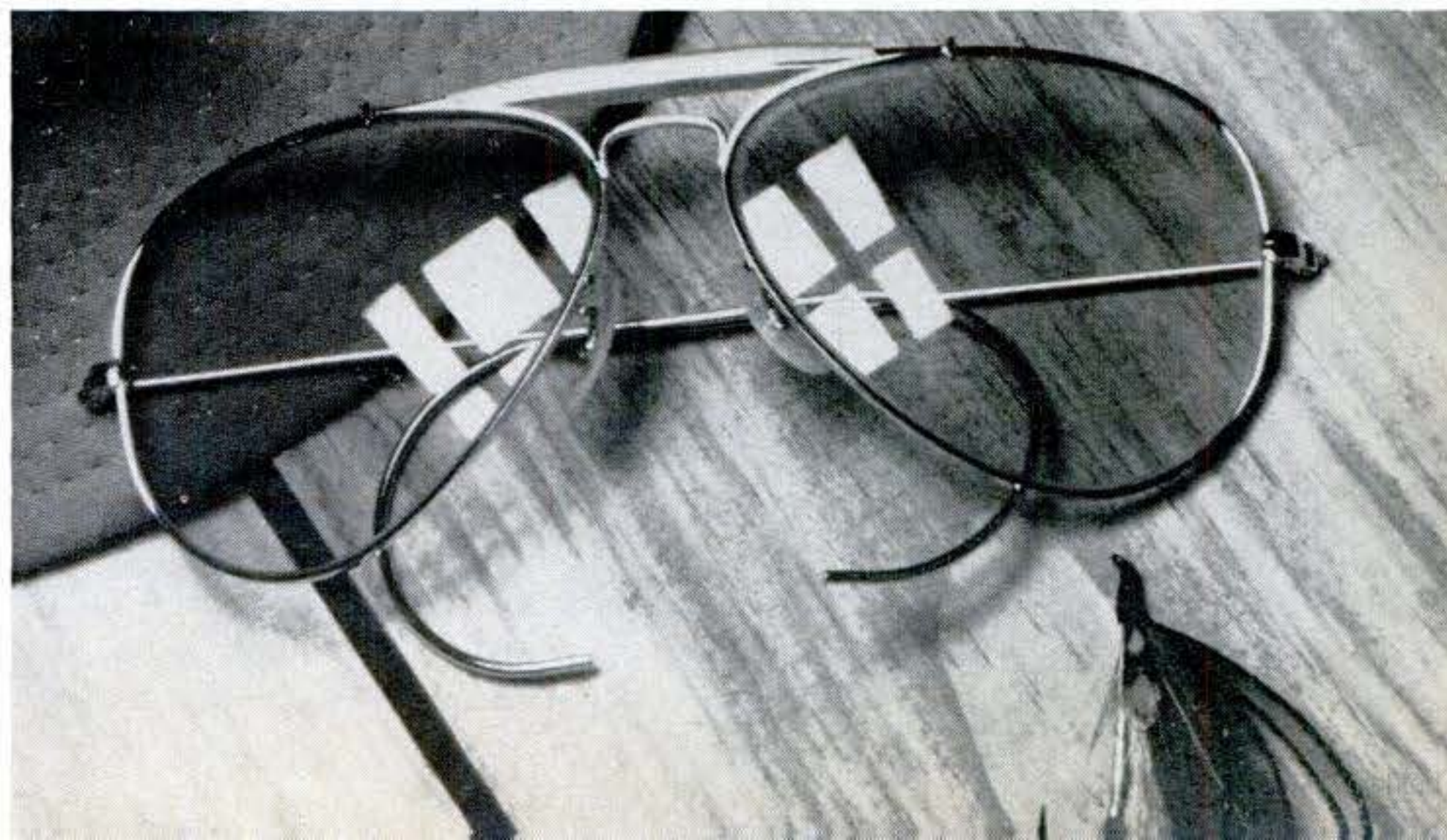
Want to join one of more than 100 teams that will travel to 32 countries and 16 states on research expeditions this year? You don't need any scientific training, but you will have to work and pay your own way. The trips are sponsored by Earthwatch (Box 127, Belmont, Mass. 02178). Some destinations include: Guatemalan jungles, Mayan ruins, a Galapagos island, Hawaii, Costa Rica, Lapland, and New Guinea.

Earthwatch says volunteers are expected to help the professionals who lead the tours—not stand around and watch. For the opportunity, you'll have to make a tax-deductible contribution of \$490 to \$950 to Earthwatch, and pay your own way to the expedition's departure point. A 36-page brochure describing the trips is free.

Things to write for

If you're planning a trip to Canada, a new 36-page guide, "Fishing and Hunting in Ontario/Canada 1978," should be helpful. It lists travel packages, accommodations, and fly-in services, and features a directory of guides. It also pinpoints the best areas for hunting and fishing various species. You can get a copy from Ontario Travel, Queen's Park, Toronto, Ont., Canada.

"Light Truck Buying Made Easier" is a helpful 128-page booklet that has lots of information on trucks, four-wheel-drives, and trailer-towing packages. Write Ford Motor Company Listens, Box 1978, The American Rd., Dearborn, Mich. 48121, for a free copy. PS



Diesel pickups

—better mileage,
but do they really save?

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Chevy	Dodge	International
Fuel economy	3	3	3
Acceleration	3	0	0
Braking	1	4	4
Handling	2	0	1
Maneuverability	3	3	4
Ride comfort	2	2	1
Quietness	0	0	0
Roominess	3	5	4
Visibility	3	3	4
Entry/exit ease	4	4	4

By JIM DUNNE
and RICH CEPPOS

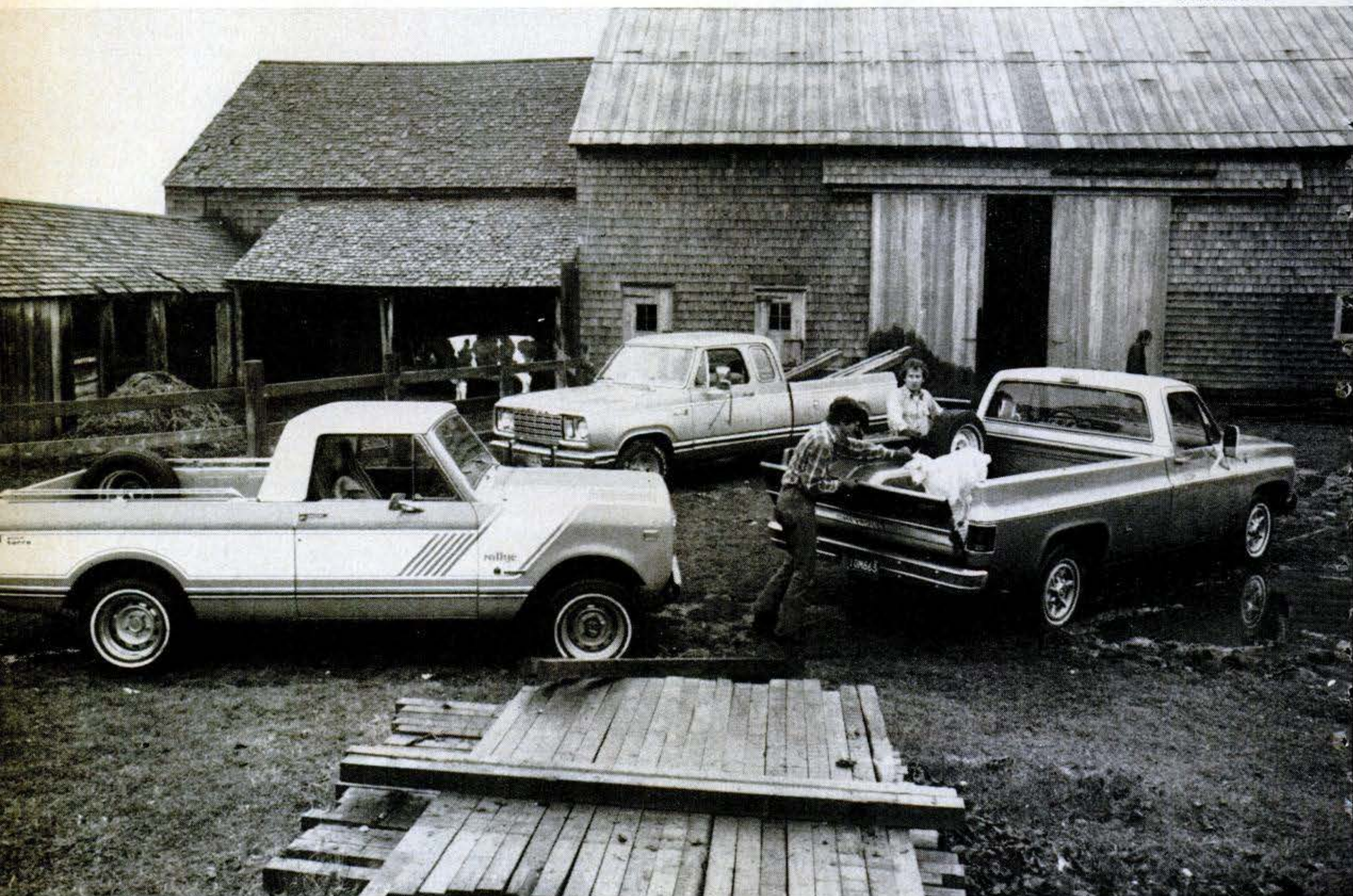
Interest in diesel-powered vehicles is at an all-time high, and with the 1979 federal fuel-economy standards for light-duty trucks just

around the corner, it's not surprising that automakers are beginning to offer diesel engines in their light-duty pickups.

How do the new diesel pickups stack up? Are they more or less expensive to operate over the long

run than gas-powered versions? And what are they like to live with? To find the answers, we tested one example of each diesel pickup: the Chevrolet C-10 Cheyenne (which is identical to GMC's diesel pickup), the Dodge

Continued

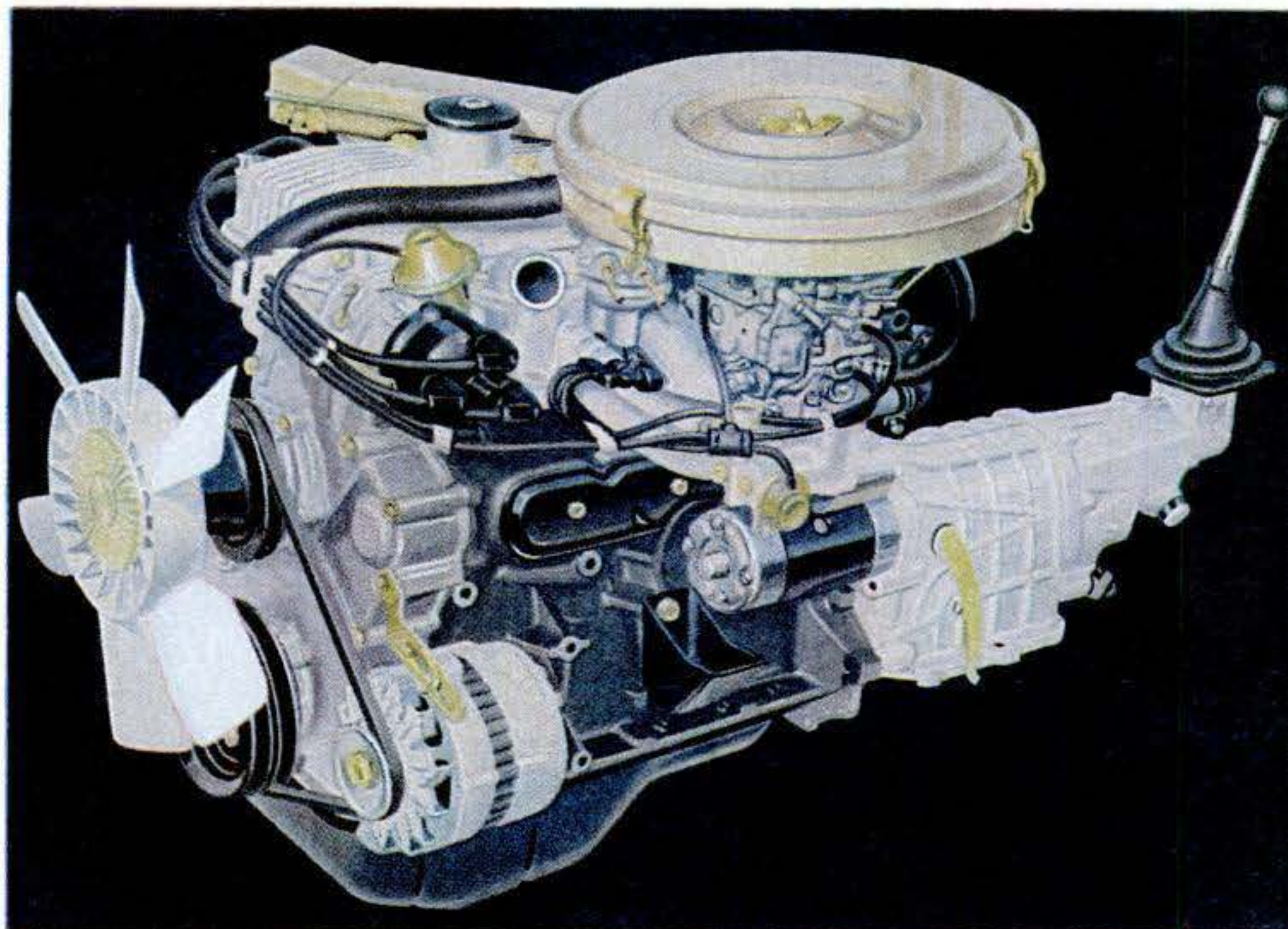


Diesel-powered International (left), Dodge (center), and Chevrolet (right)

are available with most of the same comfort, convenience, and dress-up op-

tions as their gas-powered brothers. Light-duty work is all they're suited for.

Introducing our two-barrel, four-cylinder, twelve-valve, smooth-running, low-emissions wonder.



If you're really into cars and driving, you should know more about our amazing new MCA-Jet System with Silent Shaft. We think it's one of the most significant engine developments to come down the pike since the first American high-compression V8.

First off, it offers all the advantages of a four-cylinder engine...but without the vibration usually associated with the proverbial "four-banger." Its unique Silent Shaft design (available only with the five-speed manual and automatic transmissions) is the reason. Two counterbalancing shafts rotate in opposite directions to cancel out the noticeable power pulses inherent in normal four-cylinder designs.

Now comes the MCA-Jet

part of our system. MCA stands for Mitsubishi Clean Air. The MCA-Jet System meets...even exceeds...the stringent emissions requirements now in effect in both Japan and America. Without loss in performance, too. A revolutionary new cylinder-head design that incorporates a third, or "jet," valve does the job. This valve introduces an extra swirl of air into the combustion chamber

which swirls the fuel-air mixture and promotes a faster, more even, thorough burning of the mixture at ignition.

The MCA-Jet System. It's a simple, yet highly sophisticated, answer to a very complex problem. The kind of answer you would expect from people who care about cars and driving as much as you do.

A cutaway of our amazing little engine.



Induction and compression phase.



Ignition and combustion phase.

MCA-JET SYSTEM.

Exclusively available on Dodge Challenger, Dodge Colt, Plymouth Sapporo, and Plymouth Arrow.



MITSUBISHI
MOTORS CORPORATION



Despite premature rear-brake locking, all three test trucks stopped impressively short with a minimum of slewing.

Adventurer SE 150 Club Cab, and the International Scout Terra Rallye.

Chevrolet

Chevrolet uses the Olds-developed 350-cu.-in. V8 diesel, one of the most refined diesels on the road. It's available in pickups with a gross vehicle weight rating (combined weight of truck, passengers, and cargo payload) of up to 6200 lbs.

Starting is simplicity itself: Turn the key to the first notch and wait 15 to 60 seconds for a "wait" light on the dash to flash off and a "start" light to go on. The engine lights right up with virtually none of the white smoke that's normally a problem with diesel ignition. Like most diesels, the Chevy idles a bit rough when cold, but when warmed up it's about as smooth as a gas engine. Chevy claims that the diesel will start without the aid of the standard engine-block heater at temperatures as low as -10°F .

Once under way, the Chevy diesel is little different from a gas-powered truck. With 120 horsepower on tap, there's plenty of power for relaxed highway cruising, safe high-speed passing, and easy hill climbing.

At all speeds there is a trace of the characteristic diesel "marbles-in-a-coffee-can" sound, but the

vehicle is actually no noisier than a small sedan.

The excellent noise insulation is matched by impressive control of diesel odor. There are no noxious fuel-tank fumes, and only rarely does a wisp of exhaust smoke find its way into the cab.

Since the EPA does not rate pickups with a GVWR above 6000 lbs., we checked fuel mileage during our test session. The driving included about 150 miles of highway cruising, about 50 miles of stop-and-go driving, numerous flat-out acceleration runs during our track testing, and long periods of idling during the photo sessions. Despite such hard use, the Chevy returned a 17.2-mpg average. Experience leads us to believe that they're capable of about 25 mpg on the highway.

In most other respects, the diesel Chevy C-10 Cheyenne is identical to any gas-powered model you can buy. Its interior is handsome, but suffers from a lack of leg room. Its ride and handling are good in relation to other pickups, but still below average for most cars.

The Chevy diesel does have one significant drawback: high operating cost. We compared the basic operating cost of the diesel with the gas engine closest in performance, the 250-cu.-in., 115-hp in-line six. We calculated basic operating cost, using EPA figures for mileage and fuel price, and also figured in the projected maintenance costs over

Fuel mileage (mpg)

	Chevrolet Dodge		International
Combined city/highway/track	17.2	18.2	20.6

the expected life of the trucks (the GM diesel is not designed to last any longer than the gas engine). Depreciation, which cannot be predicted, was not included. We found that it will take at least 100,000 miles, if not more, to recoup the extra \$1300 you spend to buy the diesel engine. So, though the Chevy diesel is ultra-refined, it's not going to save you money in the long run.

Dodge

The Dodge diesel is a 243-cu.-in. in-line six manufactured in Japan by Mitsubishi. Unlike the Chevy engine, it was designed from the outset as a light-duty truck diesel. Economy, power, and durability are of prime importance in truck use, while minimizing noise, smoke, and odor is secondary. And judging from the Dodge's behavior, little was done to rectify its inherent diesel problems.

Starting is more complex than in the Chevy. You push a glow-plug button in the dash, and screw out the hand throttle a couple of turns to keep the engine from stalling. When the glow plugs are hot, the button pops out and you twist the key. The diesel comes to life with a roar; billows of thick white smoke—unburned fuel—pour out of the tailpipe for a couple of minutes. Dodge says it will start without a block heater at -10°F .

At highway speeds you can barely hear the radio over the din, and you have to raise your voice considerably to converse. With only 100 hp available to haul around the truck's 3800 lbs., full throttle is often needed just to keep up with traffic; expressway merging and passing have to be carefully planned. The diesel engine is available in 2WD and 4WD models with GVWR's of up to 8100 lbs.

The Dodge did return excellent fuel economy, 18.2 mpg on our combined city/highway/track test. We expect its fuel economy under less abusive conditions would be about 27 highway/18.5 city. Foul-smelling diesel-fuel fumes occasionally found their way from the tank into the cab's interior, and caused some of the testing staff discomfort.

Continued

Give your GM car our best.

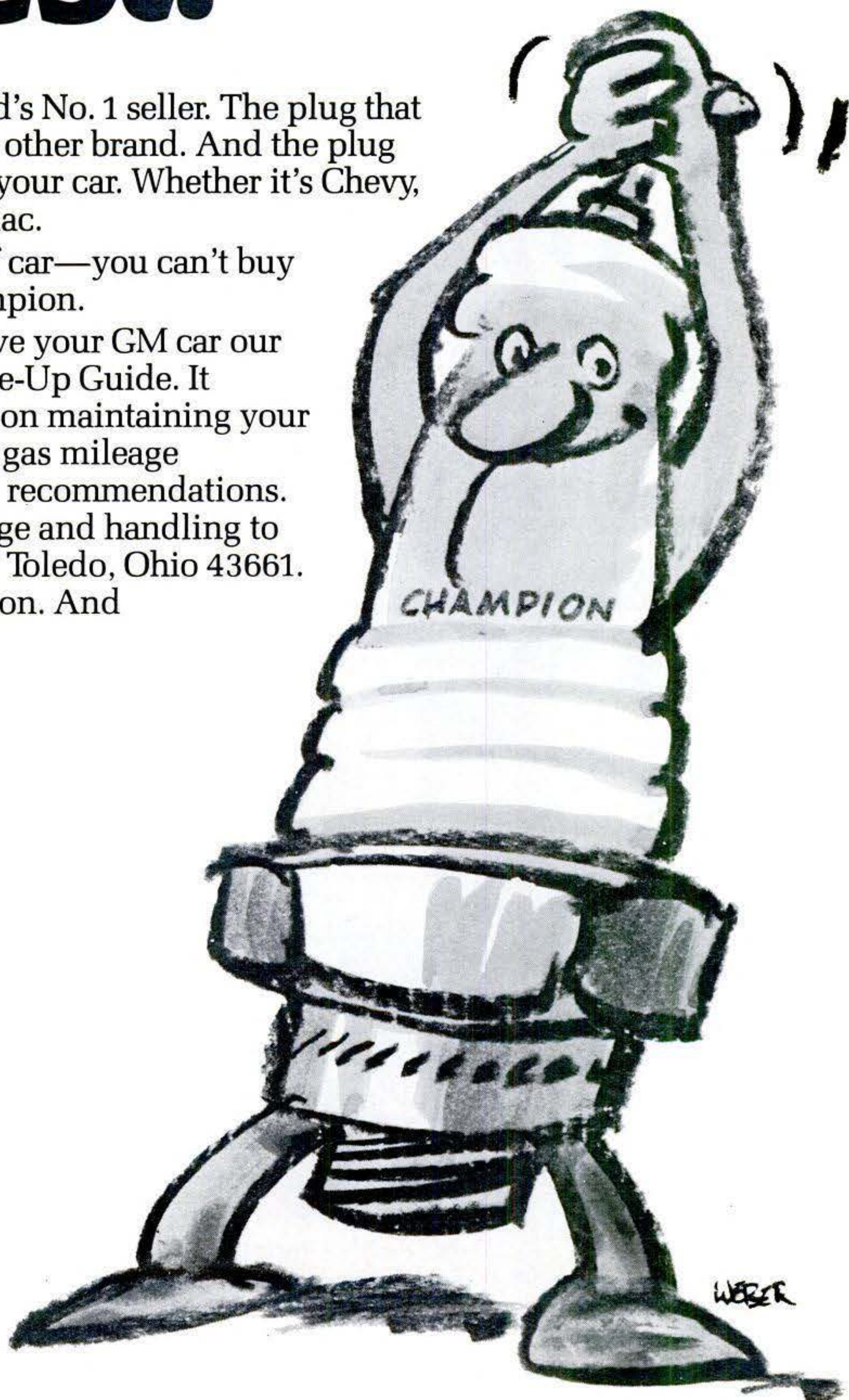
Give it Champions. The world's No. 1 seller. The plug that wins more big races than any other brand. And the plug that is made exactly right for your car. Whether it's Chevy, Pontiac, Buick, Olds or Cadillac.

For GM cars—for any kind of car—you can't buy a better spark plug than Champion.

And here's another way to give your GM car our best: Our new Champion Tune-Up Guide. It includes helpful information on maintaining your car plus a maintenance log, a gas mileage calculator and our spark plug recommendations. Just send \$1.00 to cover postage and handling to "Tune-Up," Box 910, Dept. M, Toledo, Ohio 43661. Introduce your car to Champion. And start a beautiful friendship.



**You can't buy
a better plug.**





puts you in with power, quality, com



21" Rear-Bag Rotary Mower

Maneuvers easily in tight areas—through gates, along fences, around trees. Austempered carbon steel blade with air-lift tips cuts grass smoothly, packs it into big two-bushel rear bag. Safety shear-pin blade adapter, anti-scalp disc, cushion-grip folding handle with speed control. Fully assembled with 3½ hp Briggs & Stratton engine.

174.99



Easy-lift start.



8" roller bearing wheels.



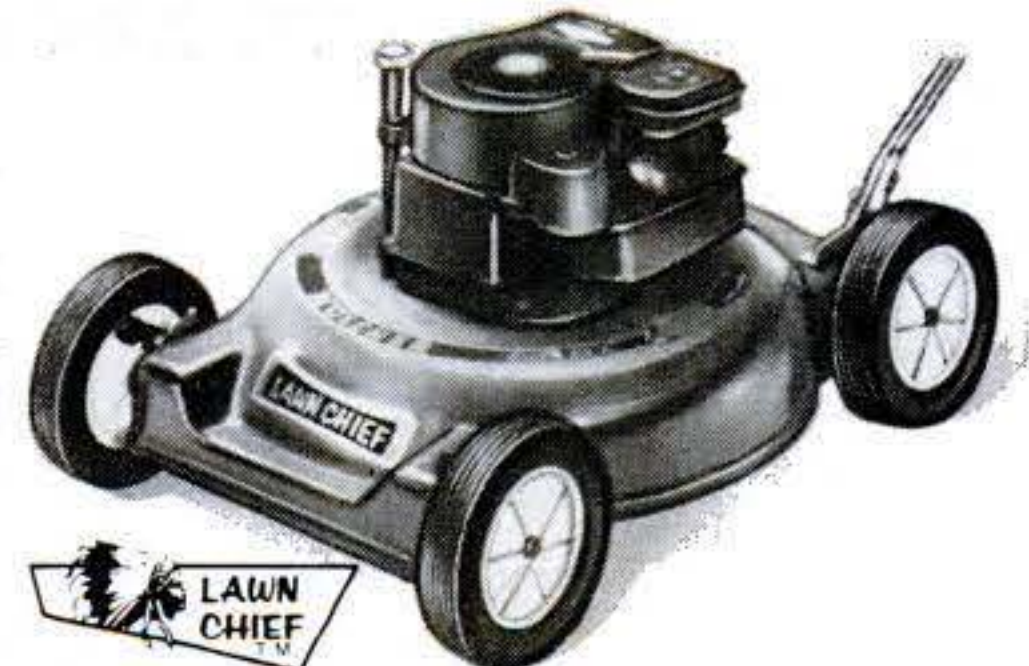
Circular baffle for efficient rear bagging.



5-position height adjusters.



Feature-packed 20" Rotary. 3½ hp Briggs & Stratton engine has easy-lift start, automatic choke. Deep-tunnel steel deck, fingertip height adjusters; 7" roller bearing wheels; austempered carbon steel blade; safety shear pin adapter; folding handle . . . **119.99**



Deluxe 20" mulching mower suspends cut grass inside deck on cushion of air, re-cuts into fine clippings that nourish lawn. No bagging or raking needed. Powerful 4 hp Briggs & Stratton engine has easy-lift start. 5-position height adjusters, austempered carbon steel cutting blade **149.99**



Instant on-off bag removes with single lever, discharge chute closes automatically.



Lawn Chief mowers are designed, tested and built in True Value Hardware Stores' own new 250,000 sq. ft. factory to assure you premium performance and lasting value.



Portatiller

2 hp chain-drive gives plenty of power for garden or flower bed. Yet it's light enough to carry, fits in car trunk. 8 double-end slasher tines till up to 18½" wide, adjust to 5 depths. **152.99**



Needie®

Double-insulated trimmer cuts 16" path along walks, drives, many hard-to-reach places. Weighs just 8 lbs., cuts quickly and safely with a monofilament line. UL listed **59.95**



TRUE TEMPER Values

Save now on quality gardening tools. Hoe scuffler quickly and easily loosens soils for growing roots. Long-handled shovel handles big planting jobs fast. Your Choice, each **4.99**

Command Convenience.



There are over 5,000 True Value Hardware Stores in 50 states. Look under "Hardware" in the Yellow Pages.



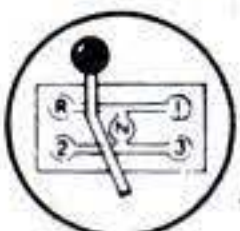
Deluxe 25" 7 hp Riding Mower

Powerful Briggs & Stratton engine features easy recoil starter, throttle control, safety key switch. Dependable gear and chain drive, single clutch/brake pedal. 15" rear, 10" front wheels, padded contour seat, rugged steel hood and parking brake. This is the next best thing to having your own groundskeeper!

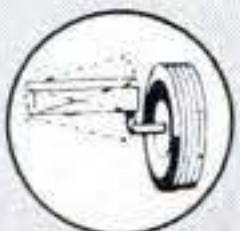
479.88



Easy-turn geared steering.



3 speeds forward, plus reverse.



Floating front stabilizer.



Lever controlled height adjusters.



Automotive type differential.

JACOBSEN.

20" Twin-Blade Mulcher

4 cutting edges clip grass into tiny particles which quickly become rich lawn food. No bag means extra maneuvering ease, lets you mow close to obstacles on 3 sides. Power Burst® control on handle instantly increases blade speed to cut through tall or wet grass without stalling. Self-propelled.

269.95



5 hp 25" Rear-Engine Rider

Rear-weighted design adds stability and safety, plus more riding comfort, to this easy-handling mower. 3 speeds forward plus reverse. Convenient recoil-start engine with safety key shut-off. Floating front deck follows ground contour to reduce scalping, provide even air-flow for efficient grass discharge. Heavy-duty differential with single clutch/brake pedal, separate parking brake. Big 13" auto-type steering wheel.

394.88



TRU-TEST DELUXE Garden Hose

Rubber and vinyl together in double-reinforced belted radial construction assures super strength plus easy-handling flexibility. 5/8" I.D., solid brass couplings. 60-ft. **11.99**



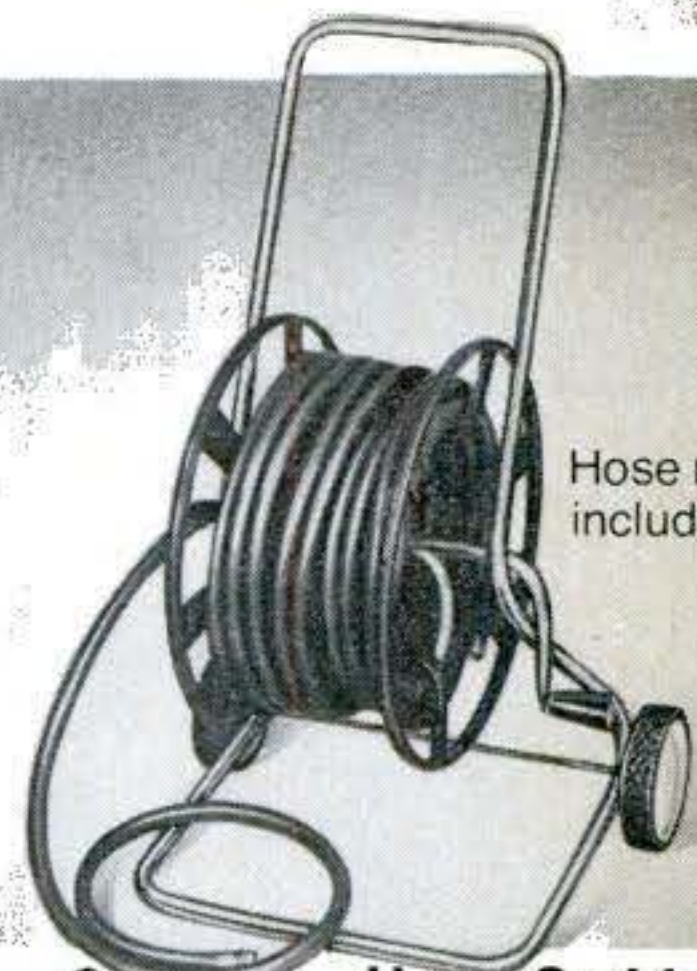
RAIN BIRD Sprinkler

You can set it to cover all or any part of a circle from 30' to 76' dia. Diffuser pin adjusts for heavy or fine spray. Sled base has extra hose outlet for connection in series **4.99**



TRU-TEST DELUXE Vinyl Hose

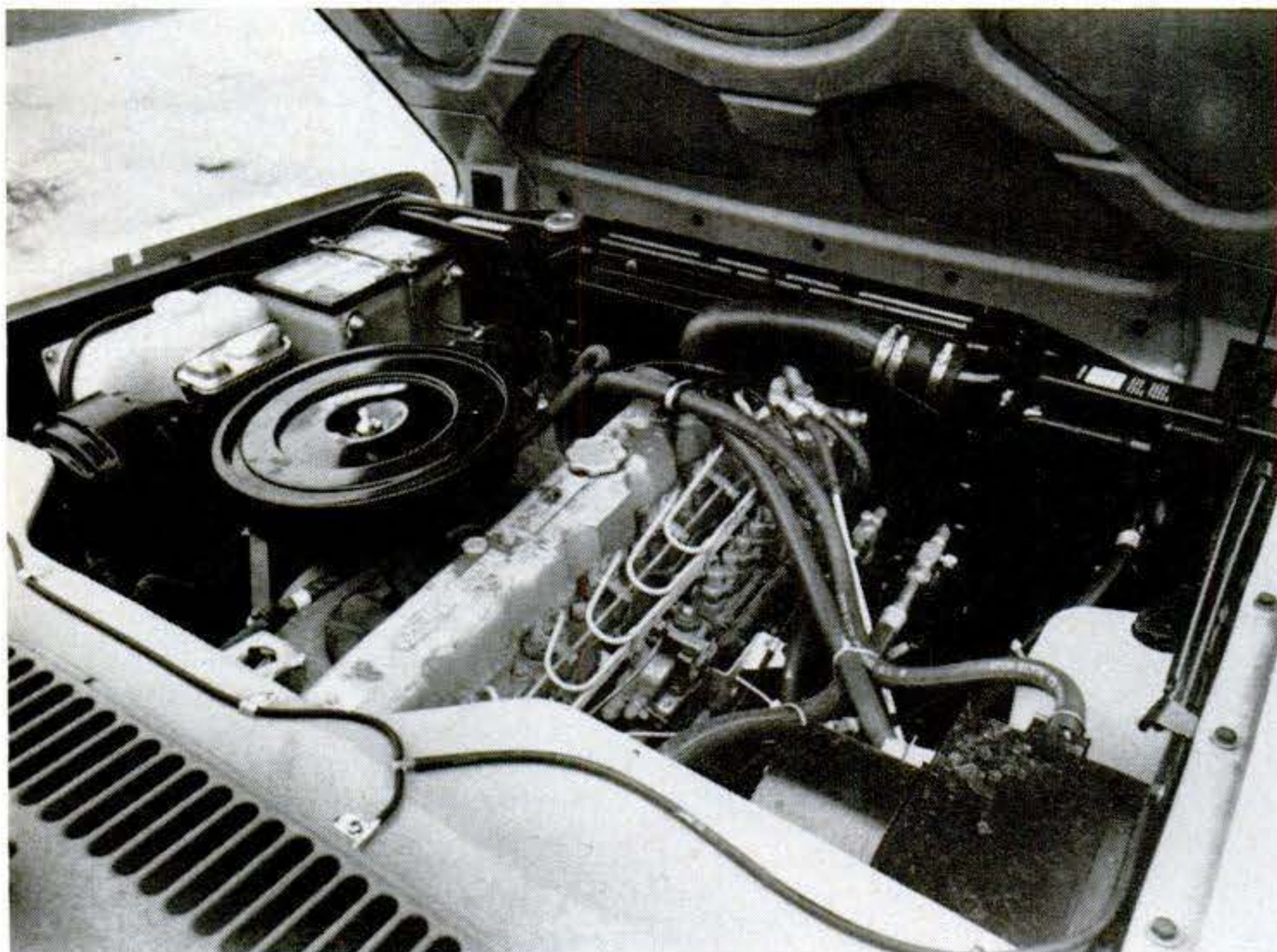
Lightweight, easy-to-handle vinyl hose reinforced with nylon for high burst strength. Stays flexible in all temperatures. Rustproof solid brass couplings, 5/8" I.D. 60 ft. long **7.99**



Specialty Hose Caddy

Holds up to 200 ft. of 5/8" hose for tidy storage and kink-free roll-out. Front-flow design is easy to use and extra stable. Big 6" wheels, green baked enamel finish **26.95**

Hose not included.



Scout diesel (shown) and Dodge in-line sixes were designed for trucks. They are more durable than gas engines, but suffer from excessive noise and low power output, and smoke badly when cold.



Pedals in Scout were too close together, making driving more of a chore. Interior sometimes smelled of diesel fumes.



Dodge Club Cab had inward-facing fold-down jump seats that we used on short trips, plus plenty of storage space.

The only benefit of the Dodge diesel's truck-type design is increased longevity. "We expect the diesel to live longer than an equivalent gas engine," says Dale Reeker, a Chrysler product-planning analyst. "That's because diesel truck engines use heavier, sturdier parts, premium materials, and more bearing-surface area."

How much longer will the diesel last? "We really can't predict that," answers Reeker.

Since a ball-park figure can't be placed on the Dodge diesel's durability advantage, it's almost impossible to predict whether it will be cheaper to run over the long haul. But considering that it costs over \$1300 more than Dodge's 225-cu.-in. six, it will have to live quite a bit longer to be a real money-saver.

With a gas engine, we think the Dodge would be a very pleasant truck. It equals the Chevy in ride and handling. The stretched cab provides gobs of leg room for the driver and plenty of extra space behind the seats.

International

The Scout's 198-cu.-in. in-line six-cylinder engine is also from Japan, and is built by Nissan. It's a light-duty truck diesel that's as unrefined as the Dodge.

The Scout is complicated and inconvenient to start. You must push in a fuel shutoff knob, then hold in a button while the glow plugs heat. When an element next to the button glows, you twist the key (which controls only the start-

er and electrical system). Like the Dodge, the Scout throws up a smokescreen of unburned fuel until it's warmed up.

With only 81 hp, the Scout has a hard time staying out of its own way. It is almost as slow as the Dodge, taking a leisurely 30 seconds to reach 60 mph. A buzzing shift lever in concert with the noisy engine is annoying at anything much over 30 mph, and makes conversation at highway speeds very difficult. In fact, it's the noisiest vehicle we've ever tested.

Diesel fumes find their way into the Scout's cab sometimes, too. The interior is less luxurious than either of the other test trucks' and it can't quite match their ride, though handling is about the same.

It was hard to pin down whether the Scout has any cost-of-operation advantage over the 86-hp, 196-cu.-in. four-cylinder gas engine, despite its 20.6-mpg average during our test. "We expect it will last longer than the gas engine, but it's impossible to predict by how much," says Ian Kinoshita, sales manager for Chrysler Diesel (Chrysler distributes Nissan diesel engines in this country).

The best feature of truck-type diesels, he adds, is their rebuildability. "Cylinder sleeves and valve seats can all easily be replaced so you can rebuild it indefinitely."

The Scout diesel and gas models both have 6200-lb. GVWR's, so no EPA figures are available. But given the diesel's \$2000 price premium, its operating cost advantage seems marginal at best.

Since the Dodge and Scout truck-type diesels' inherent longevity and excellent economy aren't enough to offset their excessive purchase price, the only distinct advantage they seem to hold over gas engines is that they can be rebuilt indefinitely. But exploiting this advantage to the fullest might prove difficult. Many trucks won't last much past the first rebuilding because of corrosion and general deterioration over the course of 100,000 miles. So a rebuildable engine seems superfluous.

If diesel trucks are to be economically attractive to the consumer, manufacturers will have to slash prices. Until then these diesels will save fuel, but not much money. And knowing that, buyers should carefully consider whether any discomfort and inconvenience caused by these engines can be justified by the small savings they might offer.

PS

For specs and test results, turn page



The most
refreshing taste
you can get
in any cigarette.

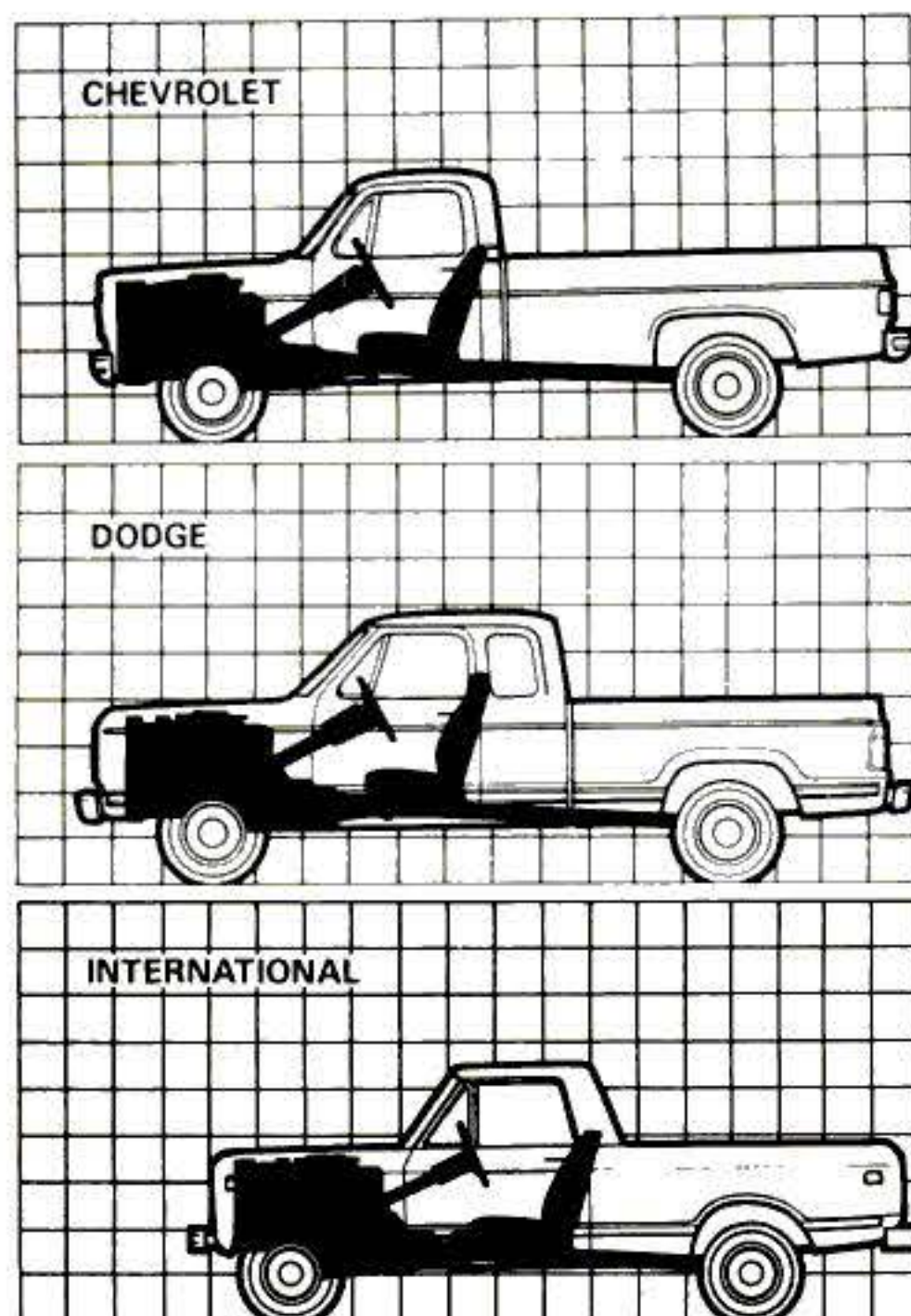


No wonder it's America's #1 menthol.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Kings, 17 mg. "tar", 1.3 mg. nicotine; Longs, 18 mg. "tar",
1.3 mg. nicotine av. per cigarette, FTC Report Aug. '77

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Trucks' height made parallel parking a difficult proposition. Bal-ky, heavy-duty, truck-type four-speed manual transmissions in Dodge and Scout made city driving lots of work. We'd opt for au-tomatics, despite the probable per-formance penal-ty. In the city, away from inter-states, finding diesel fuel was a problem — espe-cially on Sun-days.

PS serviceability ratings

How easy is it to ser-vice our test cars? For example, is that heat-er hose clamp out in the open where it can be reached easily? To give you an approxi-mation of how diffi-cult it is for a typical person to perform var-ious service opera-tions on the cars, we examine each vehicle. Here's what the num-bers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty, no worse or better than most other cars; 4, easy; 5, very easy.

Checking fluid levels:

Battery
Master cylinder
Windshield washer
Engine oil
Coolant

Checking engine:

Spark plugs
Distributor
Carb adjustment
Oil filter
Oil fill

Replacing hoses:

Top radiator hose
Lower radiator hose
Heater hoses

Changing bulbs:

Headlights
Taillights
Front running lights
Front parking lights
Front directionals
Rear directionals
Rear running lights

Checking fuses

Spare-tire accessibility

Changing belts

	Chev- rolet	Dodge	Interna- tional
Checking fluid levels:			
Battery	5	4	5
Master cylinder	3	3	3
Windshield washer	5	5	5
Engine oil	3	5	4
Coolant	4	5	5
Checking engine:			
Spark plugs	—	—	—
Distributor	—	—	—
Carb adjustment	—	—	—
Oil filter	5	5	4
Oil fill	5	4	4
Replacing hoses:			
Top radiator hose	5	5	4
Lower radiator hose	4	5	3
Heater hoses	3	5	3
Changing bulbs:			
Headlights	2	4	3
Taillights	2	2	2
Front running lights	2	2	2
Front parking lights	2	2	2
Front directionals	2	2	2
Rear directionals	2	2	2
Rear running lights	2	2	2
Checking fuses	3	5	3
Spare-tire accessibility	4	2	4
Changing belts	4	3	3

Performance comparison with selected 1972 and 1977 models

	Mpg (city driving)	Accel. 0-60 mph (sec.)	Brakes 60-0 mph (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1972 Chevrolet pickup V8	10.0	13.4	162	56.3	25.7	74
1972 Dodge pickup V8	12.0	11.5	186	53.0	23.9	73
1972 Ford pickup V8	10.0	14.9	173	54.5	25.0	74
1972 Intrnatl. pickup V8	11.0	13.6	149	56.3	23.3	74
1977 Courier pickup 4	25.0	15.4	169	60.0	29.6	75
1977 Datsun pickup 4	22.0	19.7	208	53.0	25.7	76
1977 Chevy Luv pickup 4	23.0	21.5	203	58.2	26.8	76
1977 Dodge van V8	10.5	12.1	147	56.3	25.0	76

Chevrolet, Dodge, and International—dimensions, specs, and test results

	Chevrolet	Dodge	International
DIMENSIONS (inches)			
Wheelbase	131.5	131.0	118.0
Overall length	211.4	213.0	184.2
Overall height	69.8	70.4	66.0
Overall width	79.6	79.5	70.0
Track, F/R	64.8/63.4	65.3/63.4	57.1/57.1
Ground clearance	7.3	7.0	7.6
Front head room	36.0	36.5	37.0
Front hip room	60.0	46.0	46.0
Front leg room	42.0	43.5	45.0
SPECIFICATIONS			
Engine type	V8 diesel	In-line 6 diesel	In-line 6 diesel
Displacement (cu. in./L)	350/5.7	243/4.0	198/3.2
Compression ratio	22:1	20:1	22:1
Carburetion	F.I.	F.I.	F.I.
Net hp @ rpm	120 @ 3600	100 @ 3700	81 @ 3800
Net torque @ rpm	222 @ 1800	168 @ 2200	136 @ 1600
Transmission	3-speed automatic	4-speed manual	4-speed manual
Axle ratio	3.40:1	3.55:1	3.73:1
Tire make	Goodyear	General	General
Tire type	Custom-tread steel-belted radial	Grabber	Dual Steel II radial
Tire size	LR78-15	H70-15	HR78-15
Steering	Power	Power	Power
Overall steering ratio	29.2:1	17.5:1	17.5:1
Turns, lock to lock	3.3	4.25	4.2
Turn diameter (ft.)	51.3	48.4	40.4
Front suspension	Independent coil springs	Independent coil springs	Solid axle, leaf springs
Rear suspension	Salisbury axle, 2-stage leaf springs	Solid axle, leaf springs	Solid axle, leaf springs
Front stabilizer-bar diameter (in.)	1.0	—	—
Rear stabilizer-bar diameter (in.)	—	—	—
Emission-control equipment	—	—	—
Brakes	Power disc/drum	Power disc/drum	Power disc/drum
Brake swept area (sq. in.)	377.4	316.0	327.0
Fuel tank (gal.)	20	20	19
GVWR (lbs.)	6200	6100	6200
Maximum trailer size (lbs.)	2000	Not recommended	2000
Liftover height (in.)	32	30	25
Curb weight (lbs.)	4645	3815	3724
F/R weight distribution (%)	62/38	63/37	56/44
Basic price	\$6303	\$6371	\$8749
Price as tested	\$8526	\$8078	\$11,159
Major options on test cars	A/C (\$550), Cheyenne trim (\$438), LR78-15 tires (\$299), AM/FM radio (\$167), power windows (\$131), HD rear springs (\$40), tilt wheel (\$72), clock (\$52), 3.40 rear axle (\$17), fuel-tank shield (\$36), hubcaps (\$20)	SE pkg. (\$598), A/C (\$554), 4-speed trans. (\$152), AM/FM radio (\$358), mirrors (\$45)	Rallye pkg. (\$687), AM/FM radio (\$184), chrome wheels (\$75), custom interior (\$344), A/C (\$552), custom bucket seats w/console (\$160), auto-matic front-hub locks (\$77), HD step bumper (\$39)
TEST RESULTS			
Acceleration (sec.)			
0-60 mph	16.8	34.3	30.0
25-70 mph	21.9	27.7*	26.7*
Brake test (cool) 60-0 mph			
Stopping distance (ft.)	147	146	126
Pedal pressure (lbs.)	200+	120	180
Disc temperature (°F)	160	105	93
Brake test (hot) 60-0 mph			
Stopping distance (ft.)	200	128	143
Pedal pressure (lbs.)	151	90	90
Disc temperature (°F)	535	329	230
Interior noise @ 60 mph (dBA)	74	79	81
Handling test (mph)	56.3	51.3	54.5
Maneuverability (mph)	25.7	25.7	26.4

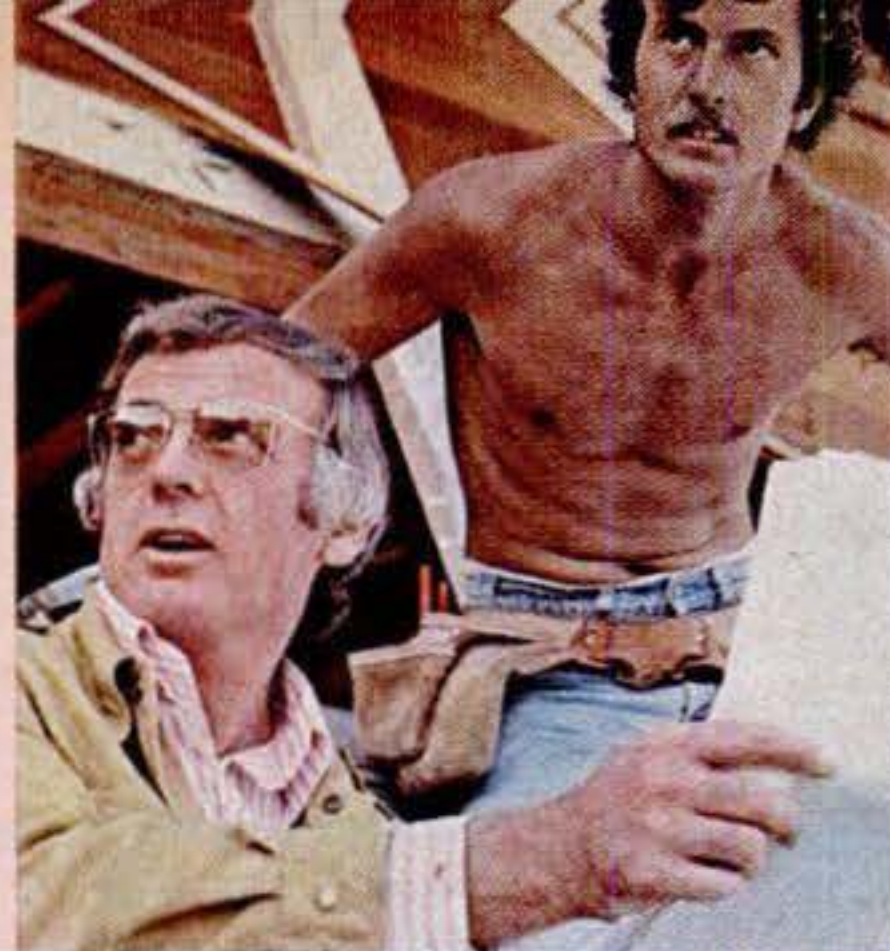
TEST CONDITIONS:

Ambient temperature, 48° F; relative humidity, 80 percent; barometric pressure, 30.1 inches

*25-60 mph

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CALCU-LETTER

By DARRELL HUFF News of pocket calculators—and how to have fun with them

Arranging your bookshelf

One of the many *Popular Science* readers who contributed to the "37-Year Puzzle" [Oct. '77] is Ken Wisniewski, Mundelein, Ill. Now he has a problem of his own to offer.

"Suppose," he says, "you had 10 books to arrange on a shelf. To discover the most pleasing appearance, you determine to try every possible arrangement, taking one minute for each. How long would this take you, assuming you work 24 hours a day?"

Once you've figured out the principle and arrived at a rather surprising result, you might try the same problem for 15 books. Don't disbelieve your answer just because it seems unbelievable.

You may recognize this as being a problem in permutation, which lies at the heart of many probability questions. It is in the nature of probability calculations to produce answers that seem to defy common sense. That's what makes them so important.

If you were to dip into one of the most widely known books on heredity, you would find this statement:

"The odds against the occurrence of such record all-son families as the Grover C. Joneses (Peterson, W. Va.) with 15 sons... are so astronomically high that pure chance as a causative factor is virtually ruled out."

You and your calculator can test this statement by figuring out just what the odds are against a run of 15 babies all being boys.

If your answer is not tremendously out of line with the number of families with 15 children that might be expected to exist, then the case of the Joneses does not back up the conclusion reached by the writer on heredity.

Hint: One way to get your teeth into this kind of problem is to consider first a family with one child, then one with two children. And so on, until you have established the method.

Anyone for roots?

Quite a few readers have called me to task for suggesting blind guess-and-try as a way to find square roots on rootless pocket calculators. It's a procedure in which, wanting the square root of 20, you might guess 4.5, and when squaring that proves it too big, try 4.48. And then 4.47, then 4.472, and so on.

As many readers pointed out, there's a quicker trick that goes all the way back to Isaac Newton. Though I

mentioned it in a PS article in December 1974, it's so useful that it deserves repeating.

To begin, make a guess. Divide the number by the guess. Find the average of that quotient and the guess. With this result as a new guess, repeat the process, checking each time by squaring to find if you've reached as much precision as you need.

Tom Szirtes, Downsview, Ont., offers an especially compact generalization of this routine, for wresting *any* root from a simple pocket calculator.

The process deals with three quantities: the number, the index, and a guess at the root. Say you're after the seventh root of 1000. Then 1000 is the number, 7 is the index. By going 2, 4, 8, 16, 32, 64, 128 on your fingers you'd find 2 somewhat low so you might make 2.5 your guess.

Now here's the formula: Raise the guess to the power of the index, multiply by 1 less than the index, then add the number. Divide this by the index and also by the guess raised to a power 1 less than the index.

Your answer should be about 2.728, and one touch on the times key and six on the equals (with most calculators) will tell you this result is somewhat too large. A repetition of the procedure, using 2.728 instead of 2.5, will bring you quite close. And a few more trials will give you the root to as many places as your calculator provides.

Those drinking guests

I trust you found a fair amount of exercise for both brain cells and calculator in the March problem about water supply. It had to do with a hotel water reservoir, fed by a spring, that could handle the needs of 770 guests for 24 days or 330 for 60 days before going dry. How many daily guests could be accommodated for a 121-day session?

We might start by calling the initial supply 1 and the daily flow X gallons. Then the flow in 24 days is $24X$, so the amount consumed by 770 guests in 24 days is $24X + 1$; in one day they would consume that quantity divided by 24. Further divided by 770 it is the amount one guest will use in one day.

Setting this fraction equal to the similar fraction yielded by the data for 60 days gives a value for X of 0.0020833 after enough arithmetic to make you happy you have a calculator.

Substituting this value for X in either of the fractions tells you that the amount of water used by one guest in one

day is 0.0000568 gallons. (The showers and toilets use running whiskey!)

If we now let Y stand for the number of guests that can be watered for 121 days, we can set up a simple equation that says $121Y + 1$ when divided by $121Y = 0.0000568$. Since X is known, a calculator quickly solves for Y , yielding 182 and a few decimals. We drop the decimals, since a fraction of a guest is too grisly to contemplate, and conclude that for a season of 121 days we can safely book 182 customers.

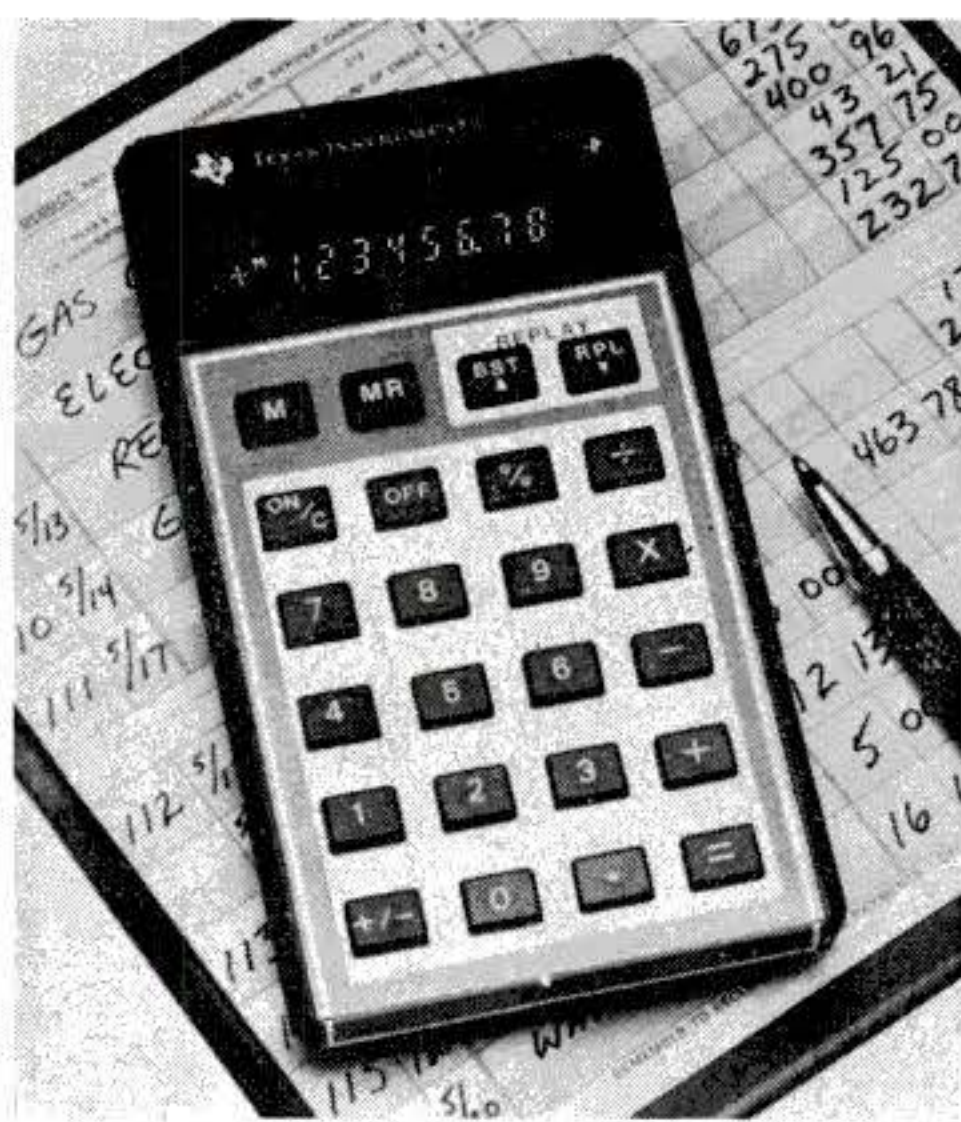
Bear or no bear

Also in March we talked about the classic bear problem. If a hunter fleeing a bear runs a mile south, a mile west, and a mile north—only to find himself right back where he started—what color is the bear? The bear must be white because only polar bears live where all directions are south—at the North Pole, that is.

But is there somewhere else on earth where you could go equal distances south, west, and north and find yourself at your starting point?

There is, indeed. Not far from the South Pole a circle could be drawn around the earth so that it is a mile long. A little closer to the Pole a half-mile circle could be drawn, and, even closer, one a third of a mile long. And so on. Starting anywhere precisely a mile north of any of these circles you could do what the problem specifies.

This one offers replay



Something new in calculators is provided by the "replay" feature on this TI-1680, designed for checkbook, shopping, budget, and other chores where errors are easy to make. It has a memory stack from which you can recall up to 20 entries for checking or editing. Under \$30, it's made by Texas Instruments, Inc., P.O. Box 53, Lubbock, Tex. 79408. **PS**

PS calculator columnist Darrell Huff (P.O. Box AS, Carmel, Calif. 93921) is the author of *How to Lie with Statistics*, *How to Take a Chance*, and other works. He welcomes comments, solutions, and suggestions.

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DETROIT REPORT

By JIM DUNNE

Mustang III

Ford has an all-new, very rakish Mustang on the way for 1979. It will compete with the Firebird and Camaro as well as the smaller sporty cars and imports. The new car features dual rectangular headlights in a "cow-catcher" front end and squared-off lines reminiscent of the Mercedes 450 SLC coupe. It will weigh about 2500 lbs. and will be offered in notchback and hatchback body styles. Some of the chassis components will be shared with the Fairmont sedans. Engines include a 2.3-liter four-cylinder, a 2.8-liter V6, and a five-liter V8. One engineering innovation is a turbocharged four-cylinder, high-performance engine available as an extra-cost item. It has the same 2.3-liter displacement as the present Mustang four, and should provide excellent fuel economy as well as superb performance. Expect about 23 mpg in combined city/highway driving, and 0-60 acceleration times of around 8.5 seconds. Since performance will be emphasized, fuel economy will not quite match the non-turbocharged four's 26-mpg combined highway/city. Ford will also offer the turbo in other 1979 small cars, including the Capri, Fairmont, and Zephyr.

Gearing up

Ford will be first out with a four-speed automatic transmission on its big-car lines in 1980. (All domestic autos now use three speeds.) GM is working on a similar gearbox, and will bring one out a year later. By that time, Ford will have begun building the four-speed for its light trucks. The transmissions are fully automatic, but have an extra gear—an overdrive—that improves fuel economy. Gas savings are termed "significant," which translates to 10 percent or more. The biggest problem in designing the transmission was to limit the amount of shifting, especially in stop-and-go city traffic. As a solution, Ford has a lock-out system that allows the driver to use only three speeds in heavy traffic, then switch to four-speed operation on the highway.

Riding on air

Air suspension may come back. Air springs can help solve a number of design problems, including how to maintain bumper height and headlight aiming with a full load, how to

improve ride on short-wheelbase small cars, and how to retain a smooth ride when using harder tires. In addition, air springs can be adjusted for softness, depending on driving needs. Air springs now being considered by automakers will be designed so that the driver can control the air pressure from inside the car, making the springs ride soft or hard to match conditions. The last time Detroit tried air suspension was in the late 1950's when GM and Ford offered the system, but the projects were a big flop. Air suspensions never really vanished however. Rolls, Mercedes, and Citroen all have versions on the road today.

Chrysler's mini-motor

Chrysler will build its own four-cylinder engine of 135-cu.-in. displacement (2.2 liters) for the 1980 small cars. The engine will be the first all-new one for the company in 20 years. A smaller version will eventually replace the four-cylinder Volkswagen engine that is now used in the Omni and Horizon. The new engines will be teamed with automatic- and manual-transmission transaxles, which will be used on Omnis and Horizons and other compact models that the company is planning for the 1980's. They will offer all of Chrysler's emissions-control systems including Lean Burn, electronic fuel distribution, and Mitsubishi's MCA-Jet combustion system (see "Three-Valve-Engine" in this issue).

A Pontiac for AMC

AMC has changed plans and won't continue using the VW four in its small cars. Instead AMC will switch to the "Iron Duke" 151-cu.-in. four built by Pontiac for its 1980 models. Before the latest switch, AMC planned to build the VW four in a plant in the U.S. That plan has been scratched. The change gives AMC a more powerful engine, and saves the \$50-100 million investment of a new engine plant. The Pontiac will provide a much-needed performance boost to AMC small-car lines and still offer good fuel economy.

The selling of a guzzler

The new 135-mph \$26,000 Porsche 928 sports car gets an average of only 13 mpg, but can still be sold in the U.S. How come? Because the Porsche is lumped together with all the high-economy cars in the VW-Audi-Porsche

group; that includes Rabbits, Dashers, and Foxes. By law, each company selling cars in the U.S. is required to meet an 18-mpg fuel-economy average for 1978. (The standard rises through 1985, when it reaches 27.5 mpg.) Because VW-Audi-Porsche has a large number of high-economy cars, the 928 can slip in under the standards.

Inventors needed

Want to make a fortune? All you have to do is come up with a replacement for the platinum and rhodium that must be used in catalytic converters. Each of the auto companies has major projects aimed at replacing these high-price metals with base-metal substitutes. GM's converters of the future use .042 troy ounces of platinum and .018 troy ounces of rhodium. That total will go into every one of the five million or so cars that GM will build in the 1980's when its new "three-way" catalyst goes into full production. The new converter, like the old "two-way" unit, is located in the exhaust system. The new one controls all three exhaust pollutants: hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x). Present converters use only platinum and don't reduce NO_x. If an inventor can come up with the substitutes, his financial future will probably be assured. But there is plenty of competition; at GM alone, technicians have already run 42 highly automated engine dynamometers 15,000 hours, testing a total of 1952 different catalyst materials. They've had little success.

Free fix

Ford will fix a shimmy in the steering system of the 1974-76 Mustang II's even though they are past their warranty period. The policy lasts until the end of next year, and covers the cars for three years or 50,000 miles, whichever comes first. The repair consists of replacing the rack-and-pinion steering-gear mounting insulators and installing a new flex-coupling bolt. It is one of a dozen or more free fixes that Ford offers its customers as part of its post-warranty "adjustment policy."

Does driver training help?

It's not clear whether driver training is really helping to reduce the total number of highway fatalities, according to a 27-state study by the Insurance Institute for Highway Safety. The study shows a much higher death rate for states with greater proportions of 16- and 17-year-old drivers. Many of these drivers have successfully completed driver-training courses. Despite the courses, their death rate remains high, above that of 18- and 19-year-olds. The conclusion seems to be that age is a more important factor in fatal crashes of young drivers than the amount of training they've received. Thus, if the minimum licensing age were moved up to 18, fewer young drivers would be on the road, and there would be fewer deaths. **P 5**

People write to



Have a question about motor oil? Lubricants? Engines? Ask the Pennzoil experts...

Sludge Solution. I recently purchased a 1970 Dodge Dart and have noticed a considerable amount of sludge build-up under the rocker arm cover and around the valve springs and tappets. What could be causing this condition? What's the best way to remove this sludge?

R.H., E. Norwich, New York

The sludge build-up is an accumulation of deposits. Short-trip, metropolitan-type driving and often extended oil change intervals contribute to this condition. One way to get rid of these deposits which accumulate in low oil flow areas is to clean them up by hand. Flushing the engine with a good flushing compound and then changing the oil and oil filter will also be helpful. To prevent recurrence of this condition, we recommend you change your oil every 60 to 90 days or 3,000 miles, whichever comes first.

Saab Story. I have a 1969 Saab with a V-4 engine. The manufacturer recommends using 80W EP fluid in its trans-axle for all temperatures and driving conditions. Will Pennzoil EP differential fluid 4096 80W-90 be satisfactory for this purpose?

T.B., Berkeley, California

Pennzoil #4096 gear lubricant is a multi-viscosity gear oil 80W-90. This means that it has the flow properties of SAE 80W at cold temperatures, and still maintains the viscosity of SAE 90 when hot. Since it can be used wherever SAE 80W or SAE 90 is required, we recommend Pennzoil #4096 for use in your Saab.



Bicycle Path. Does Pennzoil make both oils and greases which are suitable for bicycle use?

J.T., Milwaukee, Wisconsin

Two Pennzoil products can serve all lubrication necessary for your bicycle:

Pennzoil Motor Oil with Z-7 and #705 Multi-Purpose Lubricant. Pennzoil Multi-Purpose #705 can be used in any grease application and is extremely water-resistant. Pennzoil Z-7 SAE 10W would be satisfactory for all other oil applications.



Grin and Bear It. All of the bearings on my 1967 Dodge were replaced when the engine had 82,000 miles on it. Just recently, with over 160,000 miles on the car, I once again had to replace all the bearings. What causes bearings to wear out?

W.B., Zearing, Iowa

Any bearing has a life span based on the work it must perform. Its life is proportionate to how well it handles loads and temperatures, as well as contaminants while performing this work. When bearings are replaced, they should be precision-fitted, since a good fit is essential to long life. For maximum life, the dimensional proportions of engine bearings must be within the designated specifications. And the lubricating oil must be changed often enough to keep it free of corrosive combustion blow-by chemicals as well as abrasive dirt which is breathed into the engine.

Changing Times. I have a 1973 Mercury Capri which I use for towing a boat. Do you recommend changing the rear end and manual transmission oils in this car? If so, what change intervals do you recommend?

L.H., Burbank, California

For maximum gear life, transmission and differential oils should be changed on a periodic basis depending upon operating conditions. This is to remove

normal wear metals, possible moisture condensation, and to replace the additives which may be depleted to some extent. Pennzoil Gear Lubricant #4096 may be used for both the manual transmission and differential. For your 1973 Capri, we suggest drain intervals of 25,000 miles.

Oil Aboard! I have a pleasure boat with a Volvo engine, and use only Pennzoil Multi-Vis Motor Oil. I recently overfilled the crankcase by about a pint of oil, but continued to operate the boat. I have noticed a black film on the stern of the boat after trolling at idle speed for two or three hours, and suspect this was caused by the excess oil. What effect does overfilling a crankcase have on an engine?

S.E.L., Oak Harbor, Washington

Overfilling a crankcase causes splashing of oil by the crankshaft onto the cylinder walls of the engine. This excessive oil will be burned in the combustion chamber causing excessive smoking, and, as the oil is burned, deposits will form in the combustion chamber area. This can reduce engine performance and cause exhaust valve problems. If a crankcase is overfilled, the excess oil should be drained before running the boat.

WE'RE OPEN TO QUESTIONS about motor oils, lubricants, engines. But, you can tell us a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Research Department, P. O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

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More mpg from those new **super-slippery oils**

Now, oil engineers offer two ways to go for high-performance engine lubes

By E. F. LINDSLEY

Can those new, slipperier oils really save you gas? Can they extend engine life, run longer between changes, and do it all for about \$1.50 per quart? How do they compare with the more expensive synthetic lubricants, some of which make similar claims? And finally, if they can do all these things, how do they do it and why haven't they done it before now?

I sought the answers from the manufacturers of the new products as well as from outside oil experts. One of the latter, Marv Campen of Gulf Chemical, gave me a quick answer to that last question. The

push is coming from Detroit. "Fuel economy is the name of the game for car makers," says Campen. "Less friction and more slipperiness will help by giving us a five- to six-percent improvement."

Right now, two oils on the market are claimed to give improved gas mileage. One is Arcographite, made and sold by Atlantic Richfield. The other is the new Uniflo made and sold by Exxon. (I should make it clear here that I am *not* talking about synthetics, or the oils that claim to extend drain intervals, such as Pennzoil P-Z-L and STP motor oil.)

Both of the crankcase lubricants contain a "slipperiness" agent—an ingredient designed to reduce friction between moving parts of an automobile engine, cutting down on the amount of gas an engine must consume just to overcome its own

internal friction and thus giving more miles from every tank of gas.

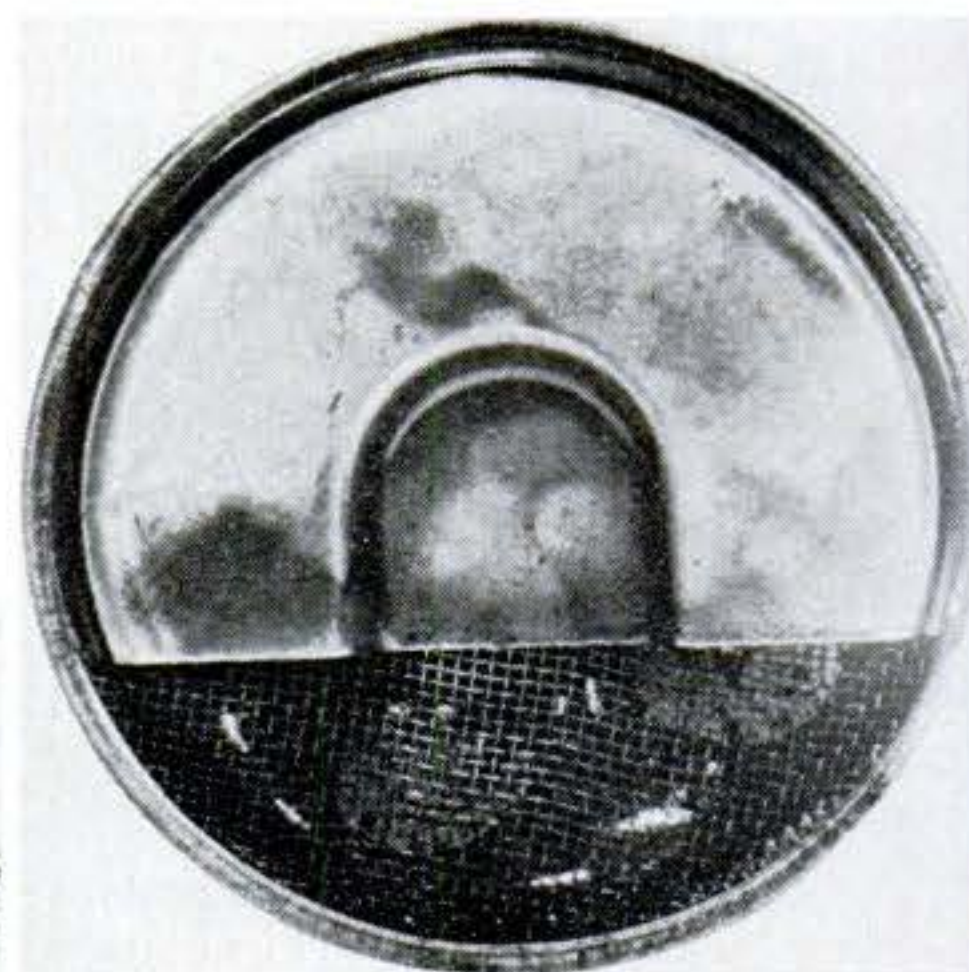
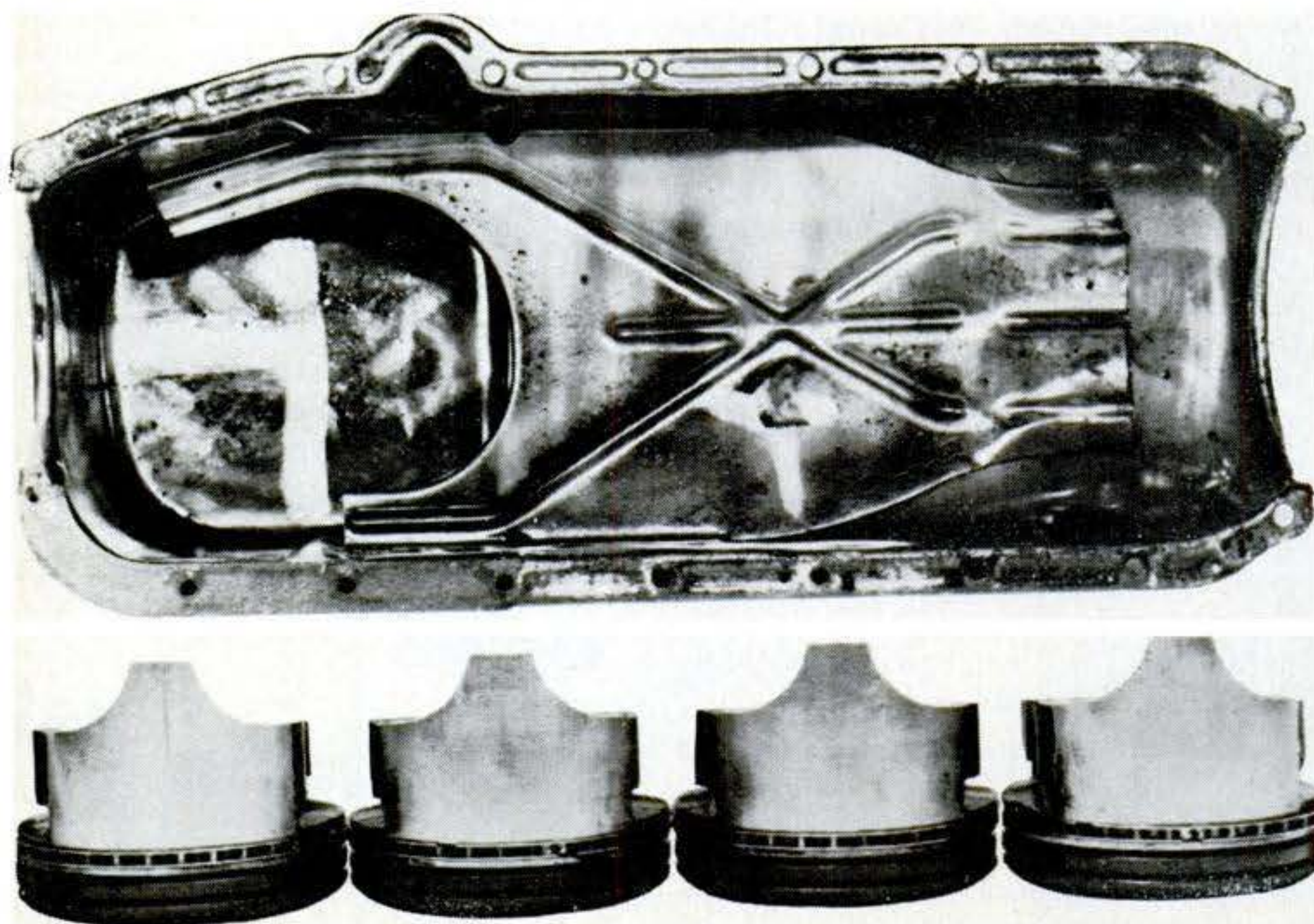
But while both of the lubricants operate on the same principle—adding friction modifiers to petroleum-based oils—the companies chose entirely different additives.

The Arco approach

Lubrication is necessary in an engine (or in any piece of moving machinery) because rubbing surfaces, despite their appearance, aren't really smooth. Look through a microscope at a finely machined steel surface that feels velvety to the touch and looks the same way to the unaided eye. Under magnification, it looks like the surface of the moon, full of jagged edges, craters, and lumps. Now imagine two pieces like this rubbing against each other. All those projections

Continued

Surprisingly clean parts are from a 1976 Bel Air Chevrolet engine that had 50,000 miles of running on dynamometer at 38-mph average. Oil pan, oil-pump pickup, and pistons were lubricated with Arcographite for this test.





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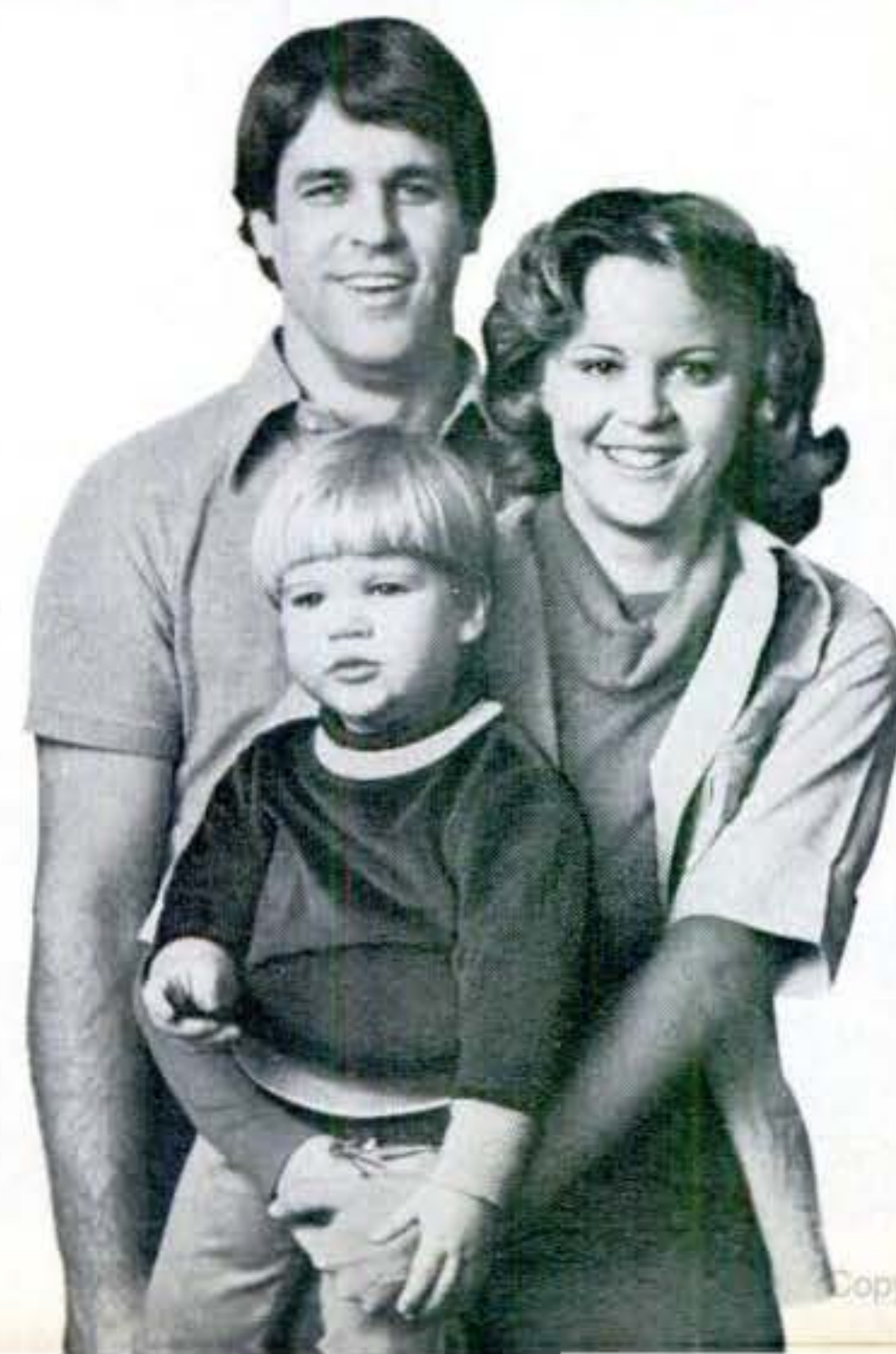
Elaine Dennis says, "It's a real convenience. Just one number to remember whenever we need any kind of help. And Vic's in the neighborhood, so it's no problem to drop by his office when we want to see him."

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Super-slippery oils

[Continued]

keep colliding, thereby impeding movement. That's friction, and you can feel it when you rub together even two smooth blocks of steel.

But put a drop of oil between them, and you'll instantly feel the difference. That's because the oil molecules form a barrier between the two blocks and keep those peaks from banging into each other. Now add some graphite and you'll sense an even further reduction in friction. Everybody knows

that graphite is super-slippery stuff. Seen under a microscope (see photo) it displays a plate-like character—and these plates slip over each other very easily.

If graphite is such a super lubricant, why didn't the experts add it to engine oil years ago? Well, they did, but there was a problem. The graphite kept settling out of the oil like a slow-motion snowfall. And that's the problem that Arco oil scientists have now apparently solved. The trick is dispersion—getting the particles of graphite permanently suspended in the oil. Although Arco is reluctant to talk in detail about how the trick was done, I did pick up some clues from Gerry Keller, manager of Fuels Research and Development for Atlantic Richfield.

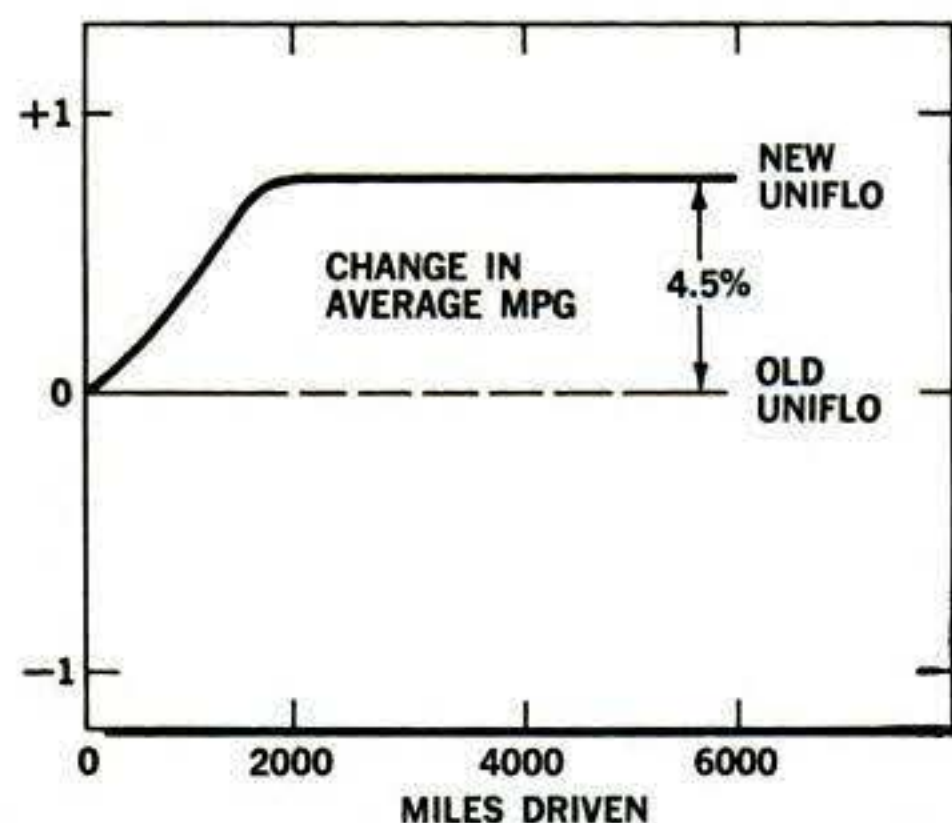
"One secret is particle size," he says. "Average particle-size distribution is much, much smaller—we're talking about four-tenths of a micron."

That's pretty small—four ten-thousandths of a millimeter. How did Arco get such small particles?

That's confidential. Next technical trick: "There's a dispersing aid in this product that keeps the particles permanently in suspension."

Each graphite particle forms a micelle, Keller continued. That's a particle in a colloidal nucleus surrounded by ions. As Keller explained it, the graphite particle is encapsulated by a material that has an affinity for the particle itself and also an affinity for the material in which you are dispersing the particle. "Think of this long molecule with an affinity for graphite at one end and an affinity for oil on the other side. That keeps particles in suspension, but keeps other things out," he explained.

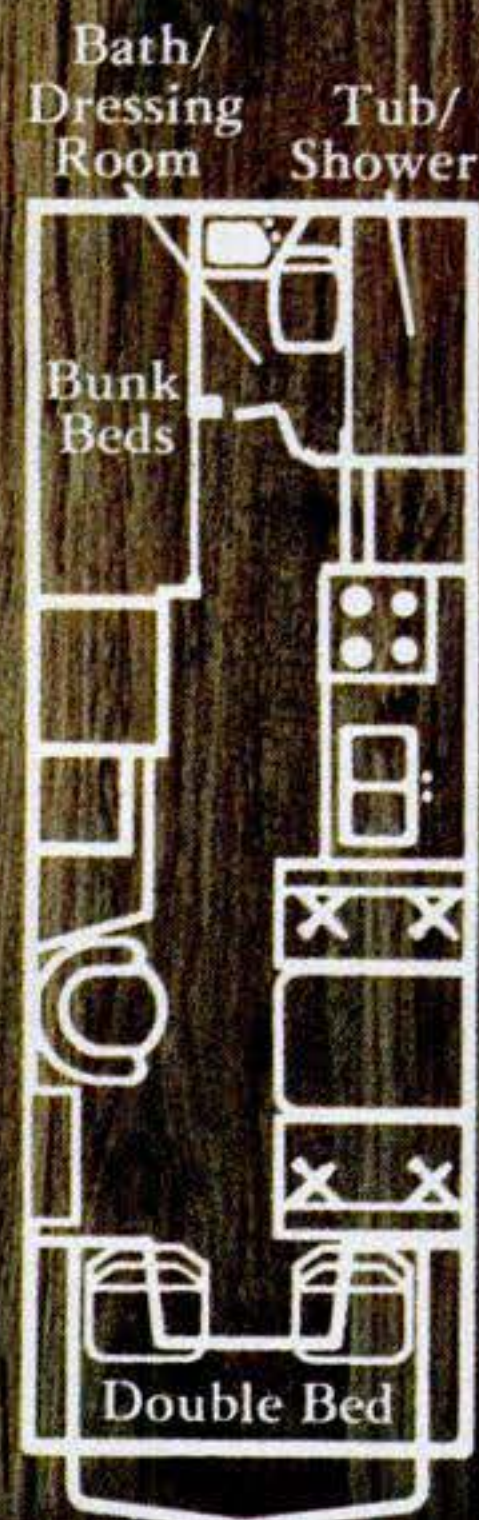
Whatever the technique, it seems to work. Out in the Arco lab I saw two 15-foot glass towers, one filled with just the graphite additive and the other with the finished oil. The towers had sampling ports every few feet from top to bottom. After 18 months of totally stagnant conditions there were no differences in graphite concentration from top to bottom.



Uniflo test fleet of nineteen 1971-77 models had 4½% mpg gain with new oil.



The Bunkhouse:



24-Foot
Minnie-Winnie

Super-slippery oils

[Continued]

Will an oil filter remove the graphite from the oil? "There is no perceptible filtering," Keller said. "Now we've got to be careful not to say that no graphite ever gets filtered out because that's an impossible statement. If you're going to filter out sludge and there's oil with the sludge, there'll be a little bit of graphite." Even so, I questioned whether the graphite particles didn't have a tendency to latch onto the foreign particles normal in engine debris and form globs and clumps.

And won't graphite eventually build up deposits in the crevices of an engine? Keller says this just doesn't happen. "We ran a vehicle for 50,000 miles on a dyno and looked to see if we'd run into any kind of fallout of the graphite, sludging, or buildup anywhere in the engine. We didn't see anything like that at all, not even in the ring grooves."

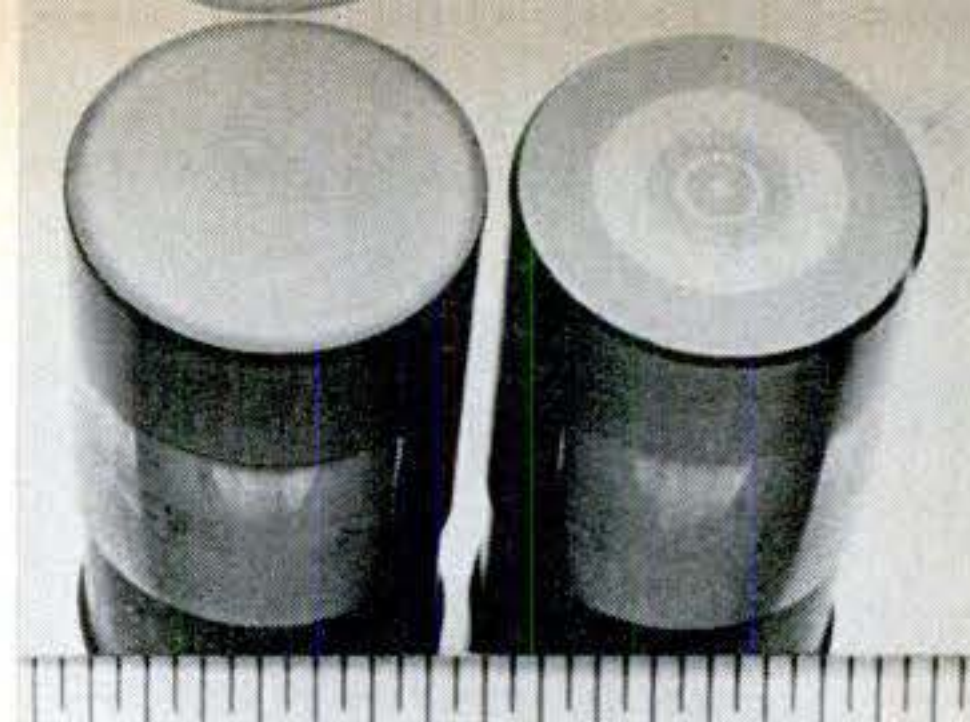
The Exxon way

It's not too hard to picture the microscopic plate-like structure of

graphite intruding between the metal surfaces to reduce friction. It's much more difficult to get an equivalent mental image of just how a chemical friction modifier like Exxon's works. You have to start with that concept of two bearing surfaces with an ample liquid film of oil between. The metals do not touch and the friction is a matter of the internal drag or viscosity and shear characteristics of the oil.

Next, picture a more closely fitted interface such as a piston ring and cylinder wall—a situation resulting in what engineers call boundary lubrication. As a spokesman for one additive supplier describes it, "You're working in the absence of a full fluid film—it's not a multi-molecule layer of oil between those parts. This is where we need additives whose chemical natures reduce friction and wear."

Some of these slipperiness ingredients, I was told, are called oiliness additives. They have characteristics that give them high affinities for the metal surfaces. This may cause adsorption on the sur-



Lifter lubed with Arcographite (left) looks good after 34,000 miles. Other, lubed with 10W-40 regular oil, shows distress pattern after 31,000 miles.

face—a thin layer of molecules sticking to the surface—or, in some cases, actual chemical bonding may even occur.

But whatever the precise mechanism—and it is not totally understood even by the engineers working on the products—some sort of plating action seems to occur. This could explain why it takes a while for the mileage improvement to become apparent. (Exxon says it may take up to 1500 miles before you get the full benefit of Uniflo.)

Just what are these magic friction modifiers? Marv Campen of Gulf Chemical says, "There are lots and lots of friction modifiers—28 different things, someone said

Continued

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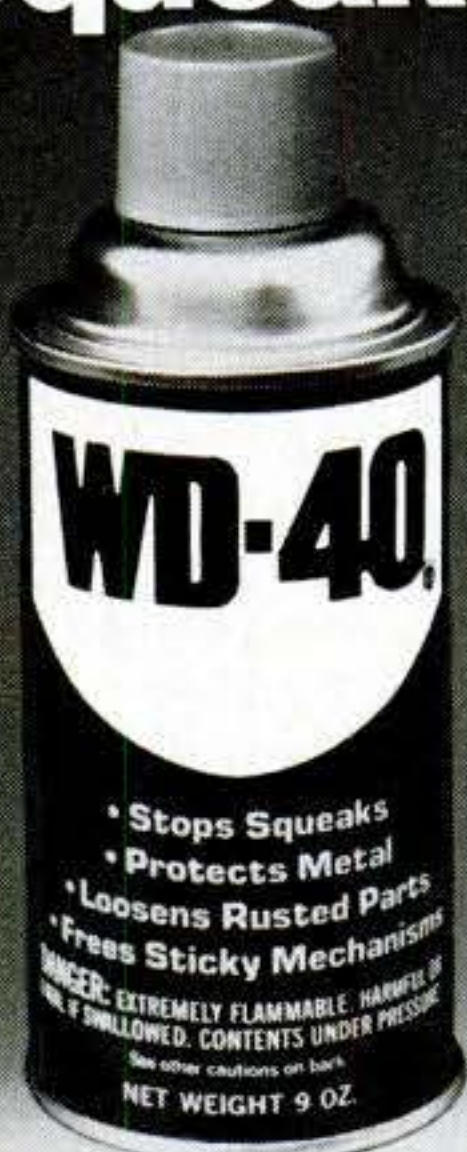
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Super-slippery oils

[Continued]

recently: sulfurized tallow, oleates, synthetic sperm oils, and all those things. They've been around for a long time in industrial machine oils."

Exxon is reluctant to say just what slipperiness agent is in Uniflo, but is reported to use sulfurized oleates. One advantage of this class of materials over graphite: They are oil soluble and actually dissolve in the base oil.

If these super-slippery agents have been around in various industrial oils for years, why haven't they been used in crankcase lubricants? Best guess is that until high gas mileage became a top priority, it just wasn't worth all the research needed to figure out the details: how to dissolve the right amount properly in an engine oil; how to make sure it would operate properly at engine temperatures; how to avoid side effects such as ash deposits.

How well do they work?

Arcographite is claimed to give a 4.8-percent average gain in gas mileage. Don Bedell, manager of Technical Marketing for Exxon, says, "Our test fleet averaged about 4½ percent." Both companies emphasize that results can vary from car to car, even between cars of the same make, model year and mileage. Bedell said, "You get different friction characteristics internally from one engine to another, so you get ranges on any make or model. Savings can range from zero to nine percent."

To get a broad-gauge, real-life picture, both of the companies have tested their product in mixed-car fleets—large and small, domestic and foreign, and old and new cars. Surprisingly, there did not appear to be any correlation between old and new cars as to mileage gained. "We didn't have too many cars with less than 12,000 miles in our

Arco fuel-economy fleet testing

	Group 1	Group 2
Number of test vehicles	23	118
Number of control vehicles*	4	29
Average initial mileage	45,000	38,000
Average age of vehicles (yrs.)	4.2	4.3
Test length (months)	4	2.5
Total accumulated miles	110,000	300,000
Avg. high temp., baseline**	81.5	74.9
Avg. high temp., test	78.6	71.3
Avg. low temp., baseline	63.8	56.8
Avg. low temp., test	59.7	51.0
Avg. improvement (%)	4.2	4.85
Statistical significance (%)	98	99
95-percent confidence band for mean improvement (%)	0.78-8.10	0.96-8.74

*Test vehicles used Arcographite motor oil. Control vehicles used a conventional SAE 10W-40 motor oil without graphite.

**Baseline refers to conditions existing at the time the control cars were measured. Test conditions are those existing when Arcographite oil was tested.

Two Arcographite test groups showed about same gain as in Uniflo test.

test fleet," Gerry Keller commented, "because with the constant gain in fuel economy you can get fooled."

The constant gain he was talking about is the natural tendency of any new car engine to wear in and progressively have less internal friction. Sometimes this reduction in friction goes on for 40-50,000 miles. It would be easy to observe this action and falsely attribute it to the oil.

The facts are that each of these oils has been extensively tested in mixed-car fleets of ordinary drivers, in cab fleets, police fleets, and, of course, in the engine labs to assure that in addition to improving mileage they meet or surpass the standard tests for SE grade oils.

What about engine wear?

Arco is openly claiming that Arcographite oil reduces wear in addition to increasing gas mileage. On the other hand, Don Bedell of Exxon says, "We have seen an improvement in wear characteristics with our product as well, but we're not ready to make that claim. It's pretty obvious that if you reduce friction you're going to have less wear. But it is not a major claim as far as we're concerned."

At best, wear claims must be treated with caution. The engineers at Arco described a test on a 350-c.i.d. Chevrolet engine that demonstrated an eightfold reduction in cam lobe/lifter wear and a nearly 100-percent reduction in ring wear. Another 150,000-mile test produced cylinder bores with the hone marks still visible. Nevertheless, Keller is



Electron microscope shows plate structure of graphite magnified 6000 times. Photo: Inst. for Inorganic Chemistry, U. of Zurich

[Continued on page 176]



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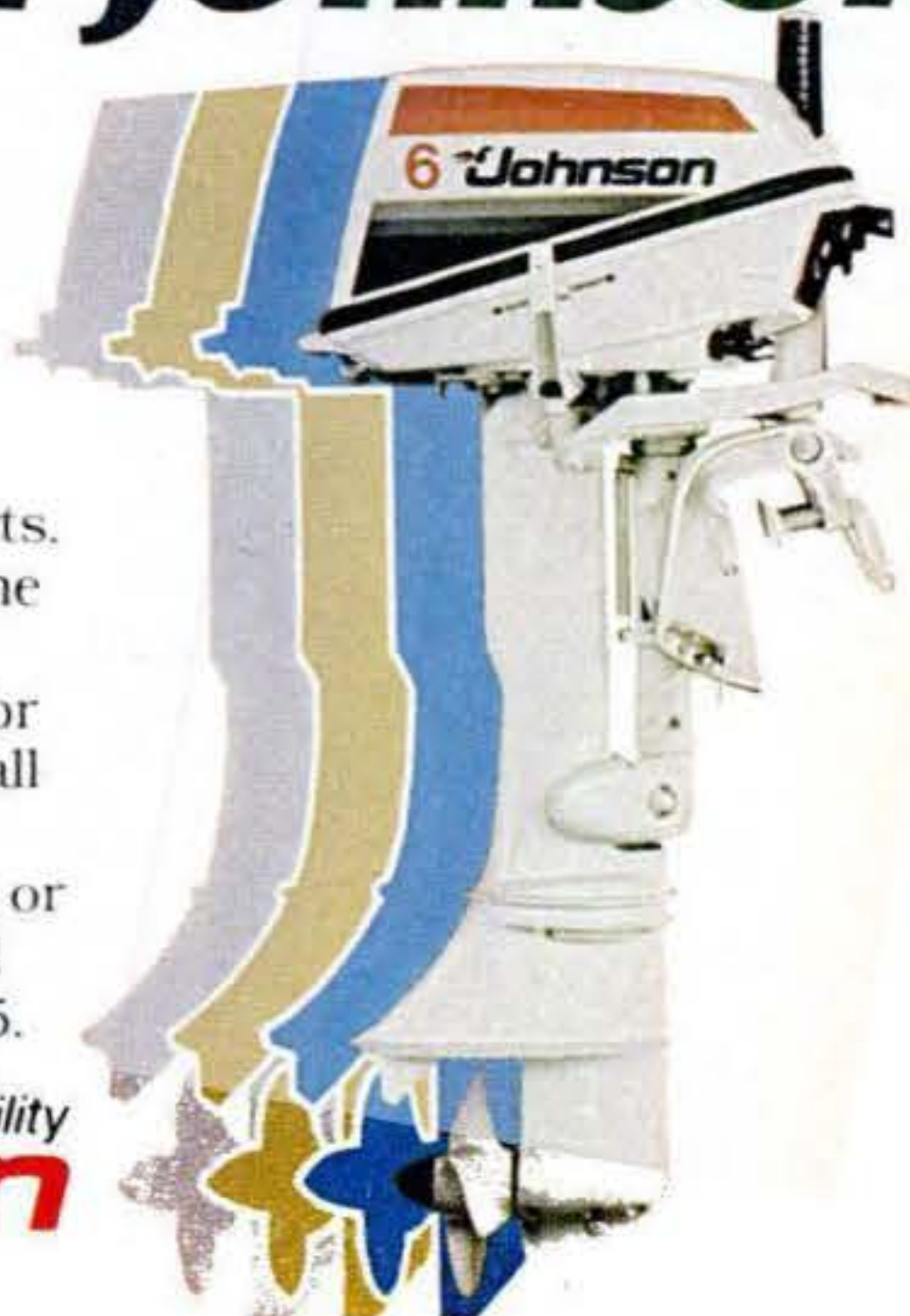
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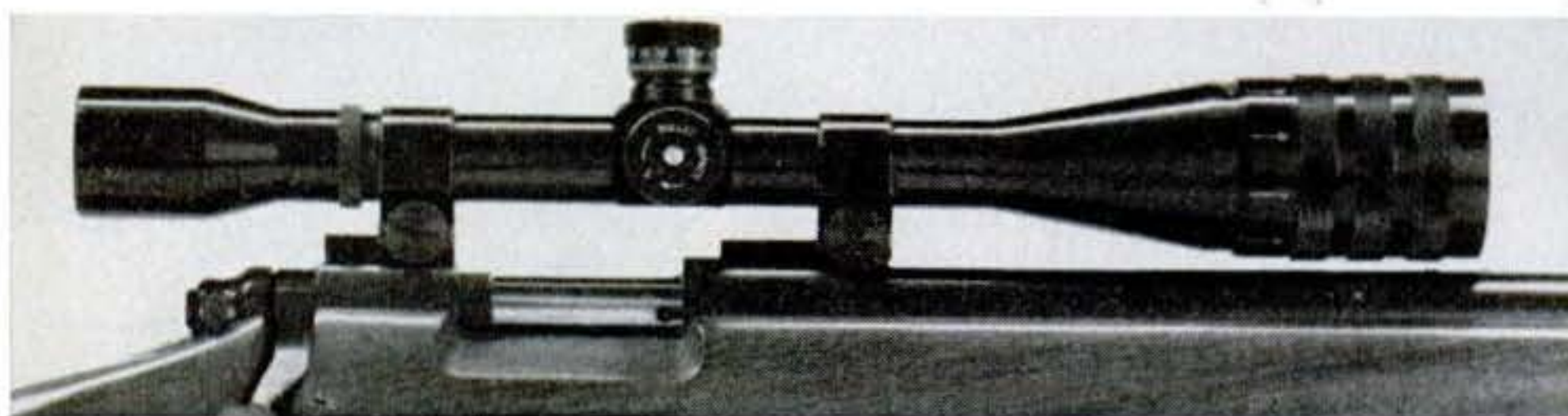


First in Dependability
Johnson
OUTBOARDS



ON TARGET

By PAUL WAHL



Scope improvement

Inside a conventional scope sight, the windage and elevation adjusting screws press against the curved sides of the erector tube. With its tendency to cause "crosswalk," this system does not provide adjustments as positive as precision shooting requires. Weaver's recently patented adjustment system, Micro-Trac, has the pinpoint accuracy and exact repeatability that target and varmint shooters demand.

With Micro-Trac, each adjusting screw, directly opposed by a strong spring, has a precise, single-point contact in a spherical shape. Edges don't contact edges.

This clever system, originally developed for the T Model target/varmint scopes, is now incorporated in all Weaver scopes for center-fire rifles. In the T Models, the spherical contact is a special carbide ball; in other fixed-power models, the ball is stainless steel, while a rounded cam-sleeve does the trick in variable-power scopes.

After testing the 10-power Weaver T10 scope on a Remington Model 40X target rifle (pictured), I'm very favorably impressed by its performance. Micro-Trac precision lives up to Weaver's claims. The focusing objective allows parallax-free settings for ranges as close as 30 feet—a boon to us basement shooters.

The Micro-Trac scope's windage and elevation-adjustment knobs, with $\frac{1}{4}$ -minute clicks, are conveniently large and have easy-to-read graduations. Once sighting-in is accomplished, each knob may be set to zero as a reference point for future adjustment. In my opinion, the new Weaver T10 is the ideal target and varmint scope.

Other T Models are the T6 and T16, 6 and 16 power respectively. For bench-rest shooting, 20- and 25-power versions will be available later this year.

The trio of T Model scopes is priced from \$150 up; mounts are extra. From W. R. Weaver Company, El Paso, Tex. 79915.



World's best air rifle

No. 1 among today's match-grade air rifles is the Daisy/Feinwerkbau Model 300S. In the 1977 European Air Gun Championships, it was used by the winners of 16 of the 18 medals awarded, including all of the gold.

Its accuracy is phenomenal. Firing a 300S from a bench rest at the standard air-rifle range of 10 meters (33 ft.), I can hit the pinhead-size bull's-eye of the official target every time. Not uncommon are three-shot groups under 0.05 inch (extreme spread of shot holes measured center to center).

The Model 300S is a 177-caliber,

recoilless, spring air rifle with easy side-lever cocking. It weighs about 10 pounds. The well-designed target stock is walnut, has a full pistol grip, Monte Carlo cheekpiece, and adjustable butt plate. Velvet-smooth in action, the advanced match-type trigger is adjustable for pull (four to 48 oz.), slack, and position. The sighting system consists of an aperture rear sight with micrometer click adjustments and a globe front sight with interchangeable inserts.

Some dealers price it at well over \$400, but now you can buy a 300S directly from Daisy (Box 101, Rogers, Ark. 72756) for \$280.



Light Load

Dry firing—aiming and snapping an empty gun—is a worthwhile exercise for improving marksmanship. But it's boring, and most shooters have to force themselves into daily sessions. Now there's Light Load to make dry runs almost as much fun as shooting live ammo—only the cost, noise, and recoil are missing.

The new Light Load conversion kit adapts standard revolvers to shoot a beam of light that registers as a bright spot on a highly reflective target. With a Light Load in my favorite six-shooter, the Ruger New Model Blackhawk 357 single-action pictured here, I'm actually enjoying dry practice for the first time in 40 years of handgunning.

Light Load installation is simple, requiring no alterations. The revolver's cylinder is replaced by a similar unit containing a tiny electronic flash and two 1.5-V N batteries. A self-aligning lens tube is inserted in the gun barrel and engages the Light Load cylinder.

When you pull the trigger, the hammer falls and the firing pin strikes a button in the rear of the Light Load cylinder to discharge the flash. The burst of light travels through the lens tube to project a bright "bullet hole" image on the reflector target. The flash unit recycles in three seconds and a \$1.50 pair of batteries delivers over 1000 shots.

Suggested range is 10 to 14 feet. The target is a standard silhouette scaled down for these short distances. Scoring areas, numbered 7 to 10 with a central X ring, are in different colors, making it easy for the shooter to keep score for himself.

Priced at \$88.88, the Light Load kit—flash cylinder, lens tube, and reflector target—is available in models for Colt and Smith & Wesson double-action revolvers, as well as Ruger single actions, in 35.7, 38, or 44 caliber. Soon there will be a kit (\$93.50) for the Colt 45 Auto, too.

For further information on Light Load, write: Jacob & Tiffin, Inc., Box 547, Clanton, Ala. 35045.

Maybe you think you wipe out dandelions when you dig them up, but it's possible you're letting yourself in for even worse trouble.

Those roots could go down as far as 2 feet and you have to get every bit of them out. Bits of dandelion root left in the lawn can start new shoots, so you can actually multiply your problems.

That can't happen when you use Scotts® Turf Builder Plus 2®. It gets rid of dandelions and forty other broad-leaved and vine-type weeds.

(That's a lot of weeds, but unfortunately there are grassy weeds that need a different treatment. Crabgrass, for instance.

For crabgrass and its ugly relatives, we make Turf Builder Plus Halts®. Apply it in early Spring, and it prevents annual grassy weeds from taking over your lawn.)

We'll get these dandelions out of your lawn, roots and all.

When Plus 2 gets onto a dandelion's leaves, the weed is doomed. Plus 2 penetrates the weed's sapstream and reaches every part. In a few days, you can see the stems and leaves twist and curl. When the weed dies in about a month, you don't even have to rake it out. It will soon fall apart and disappear. And it won't grow back, because Plus 2 took care of every bit of the root.

At the same time the Turf Builder® is hard at work. The slow-release nitrogen in this

stimulates the nearby grass to grow into the thin spots left by the weeds. It thickens the lawn by helping new grass plants grow. It feeds your lawn at just the right rate for healthy growth and keeps on feeding it for up to two full months.

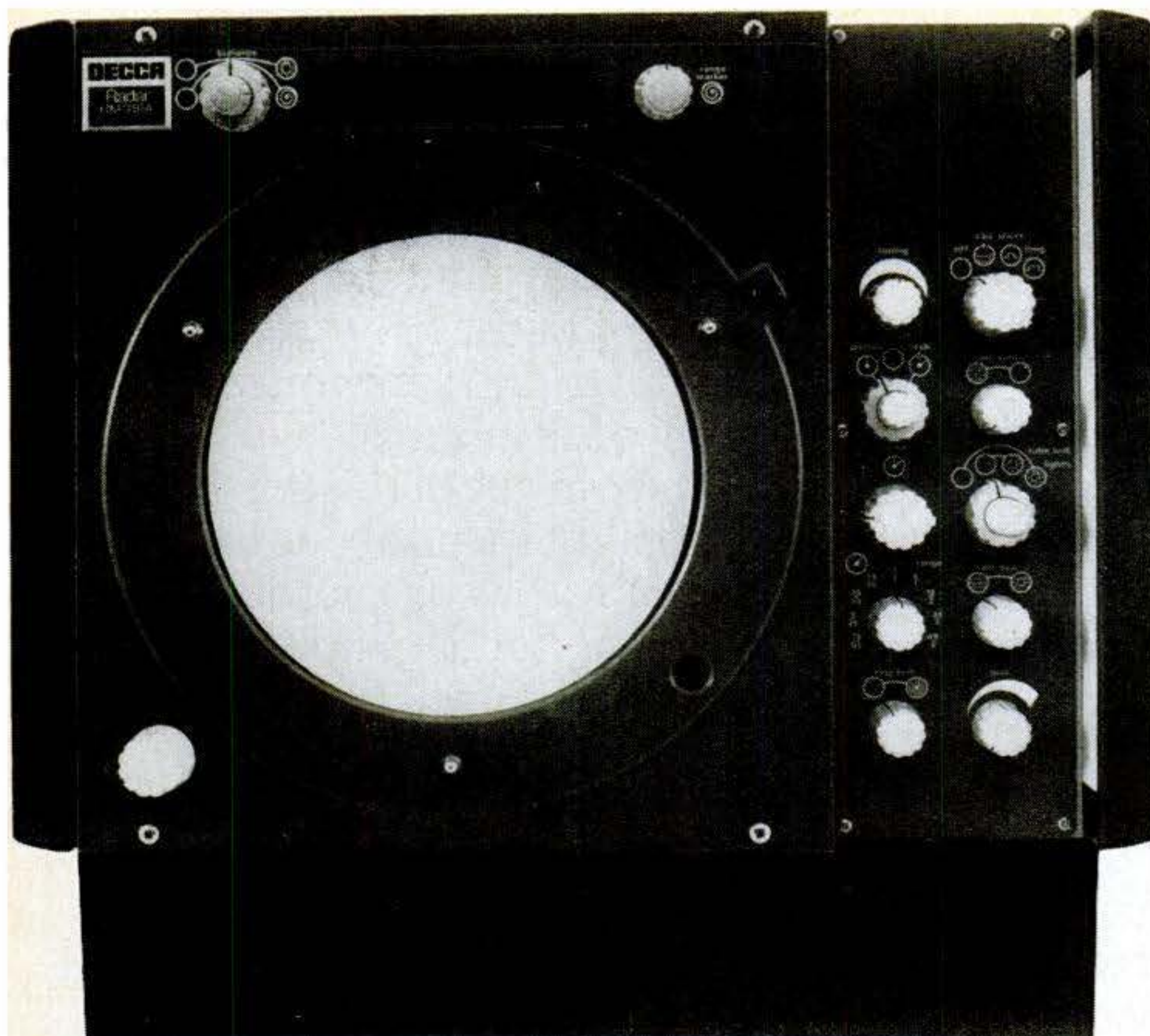
And you can get all this done in one shot. Just spend about half an hour with your spreader and our Turf Builder Plus 2. Those dandelions will be on the way out, and with them will go other intruders such as plantain and chickweed.

Thick, healthy grass makes it tough for any new weed seeds that blow on your lawn to gain a foothold. And thick, healthy grass is what our lawn products are all about.

If all weeds look the same to you, we know just the person who can help you: your local Scotts Lawn Pro.™ We've given him special training, so that he knows how to help. He's got Turf Builder Plus 2 and a lot of our other lawn products. He won't charge you for the advice and you only pay for what you buy. You can get the name and address of the Pro nearest you by calling us toll free: east of the Mississippi 800-543-1415; west of the Mississippi 800-543-0091; and in Ohio 800-762-4010.

You might also like to get our magazine, Lawn Care®. Just write us here in Marysville, Ohio 43040. It's free and loaded with good things to know about your lawn.





Display unit for Decca's nine-inch 916A marine radar houses a new clutter-sup-

pression circuit. The seven-kW transceiver section has a 48-mile range.

Marine radar eliminates image clutter

Shipboard radar screens are sometimes cluttered with echoes from rain, snow, and wave spray that mask approaching hazards. Radar operators can make adjustments that temporarily suppress clutter in a limited area. But, in doing this, they may suppress the image of an oil tanker elsewhere on the display.

Now, a new technique called Clearscan that automatically suppresses clutter without affecting less-cluttered areas on the screen has been introduced by ITT Decca

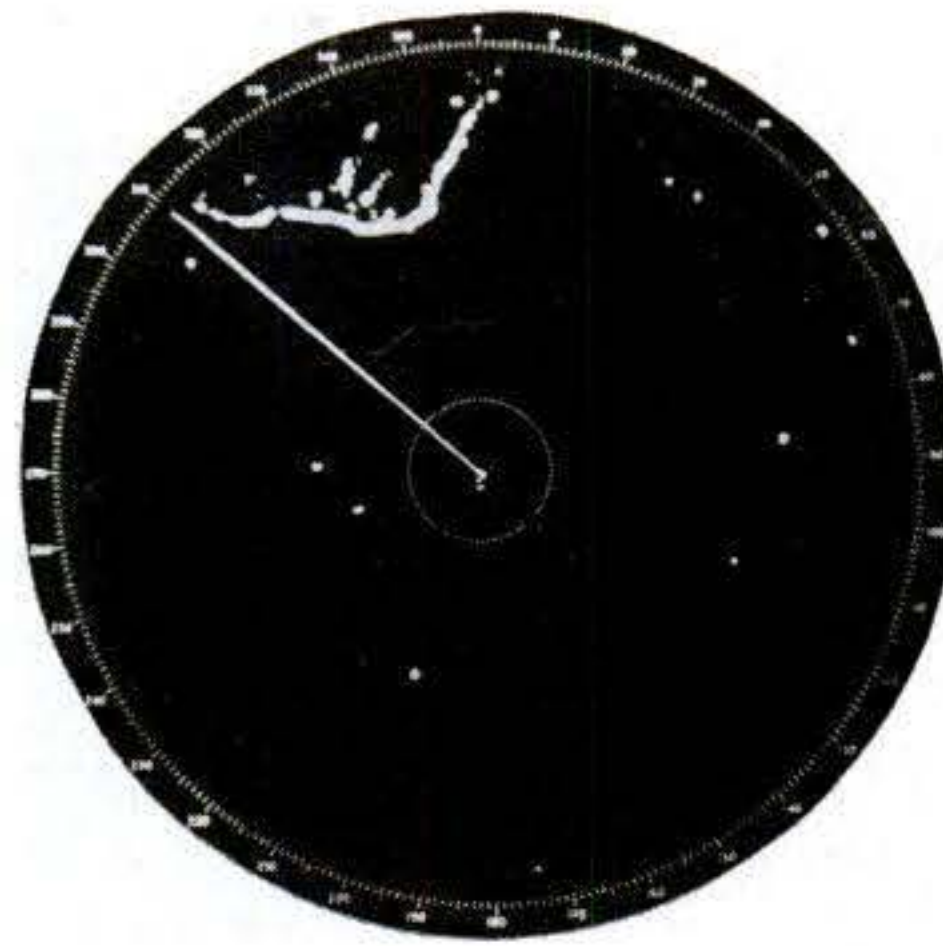
Marine, Inc. (Box G, Palm Coast, Fla. 32037). Clearscan's "adaptive" electronic circuits continuously vary radar sensitivity at every range and bearing. It accomplishes "what a very large number of skilled operators might do by hand," says Decca's Louis Foy.

Applications, says Foy, range from use on fishing boats, whose crews must spot small buoys, to very large crude carriers.

Decca's new nine-, 12-, and 16-inch radars use the Clearscan circuit. A plug-in video board retrofits some existing radars. An optional black box, available soon, will suppress receiver noise and interference from other ships' radars, and brighten weak echoes for better viewing.—*John Free*

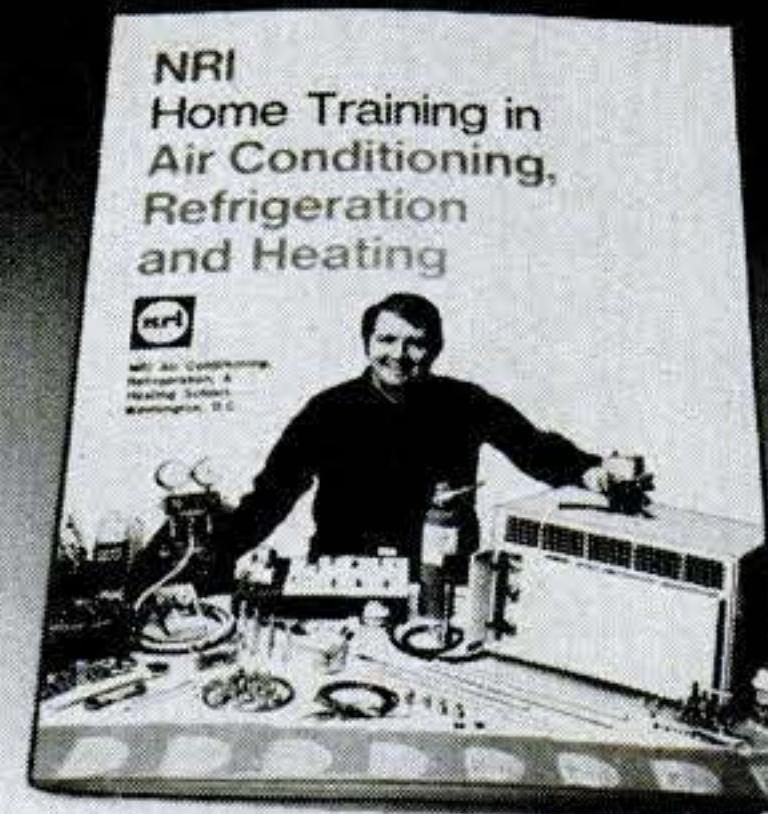


Radar clutter from precipitation and waves (left) can hide targets that be-



come visible (right) with Decca's Clearscan clutter-suppression circuit.

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LOOK AND LISTEN

By JOHN FREE



VCR's: cameras and decks

Tubeless color-TV cameras, like that used by RCA's Fred Ingle above, will eventually have a big impact on home entertainment. Paired with either portable or AC-only video-cassette recorders, compact, lightweight TV cameras can capture vacation highlights, family celebrations, or home-TV productions on low-cost magnetic tape.

RCA is the first to unveil a tubeless color-TV camera, but many other companies—among them, reportedly, Eastman Kodak—are hard at work developing models, too. RCA's development model was shown early this year, but it won't be available until 1979. The price will be steep at first, but the charge-coupled devices (CCD's) it uses in place of conventional vidicon tubes can be inexpensively mass-produced—just like calculator or TV-game microcircuits.

RCA's new all-solid-state color camera uses three postage-stamp-size CCD image sensors. Each sensor is a 512-by-320 matrix of light-sensitive elements. Charges that develop on each microscopic element are collected and transformed into a standard 525-line video signal. The main advantages, says RCA, are low power consumption, sensitivity to low light, elimination of image lag (comet-like trails behind bright moving images), and safety from damage by the sun or bright lights. Also, CCD's can't wear out as vacuum tubes do.

Japanese manufacturers aren't waiting for CCD color cameras to kick off portable VCR sales. In Japan, JVC has introduced a 20-pound portable VCR and companion color camera, each priced at about \$1000. JVC uses the Video Home System (VHS) tape format [PS, Nov. '77]. The VCR records up to one hour on a battery charge.

Matsushita, Panasonic's parent firm, may soon have a VHS portable deck, too. Sony already has a more costly color portable recorder/camera combination for the industrial market, using the Beta tape format. Home-use Beta format portables are likely soon, too.

Meanwhile, General Electric and

Quasar have joined the long-play (AC-only) home VCR lineup, offering the four-hour Matsushita VHS machine, which is marketed by various companies under their own brand labels. Hitachi may bring out a new lower-cost VHS model in the U.S. this month. The new two-hour deck requires 15 percent fewer parts than comparable models, and might trigger a new wave of VCR price cuts.

A glimpse of the features and accessories that could be included in third-generation VCR's was shown by Panasonic recently. The firm's add-on TY-M100P, which looks a little like a digital-readout FM tuner, is an automatic video-programming system. A microprocessor circuit remembers the time, channel, and weekday of up to 10 TV programs. The programmer then turns a TV or Panasonic's Omnivision VHS deck on and off during the week.

Brief looks

- Over-the-air pay TV got a boost when Sears, Roebuck announced it will begin marketing National Subscription Television in Los Angeles. Scrambled signals are broadcast over channel 52; subscribers pay \$17 monthly for a decoder to watch movies and sports. In New York, Wometco Home Theatre (WHT) has started a similar service.

- TV audio, once distributed separately by networks to local stations over telephone lines, will now be combined with picture information and sent to stations by microwave. As a result of the switch, TV audio that has often been limited to 5000-Hz response can be extended to 15,000 Hz. In addition to hi-fi audio circuits in future TV sets, the new development opens the way for stereo TV sound.

- Will a race for the most powerful hi-fi receiver develop? Pioneer started

things off early this year by introducing its model SX-1980, with a continuous power output of 270 watts per channel (see p. 104). That topped Hitachi's 200-watt Class-G model 2004 and a Marantz model. But Pioneer president Berni Mitchell expects that other firms will enter the power race and top the SX-1980's rating.

- Two-hour video discs for a modified Philips/MCA player [PS, Feb. '77]—now slated for sale this year—will gradually change speed (from 1800 to 600 rpm) as they play. The variable-speed technique boosts playing time, but eliminates freeze-frame, slow-motion, and frame-identification features possible with the original 1800-rpm, single-sided, 30-minute video discs. The updated player will handle both disc types.

- An integrated circuit for TV receivers that decodes the VIR (vertical interval reference) TV signals used by broadcasters to calibrate color intensity and tint is being sold by Matsushita. Already used in some Panasonic sets, the chip provides precise automatic color adjustments. GE, which introduced the first VIR sets in 1976 with discrete components [PS, June '76], may soon switch to a single-chip VIR system, too.

Computer-cut records

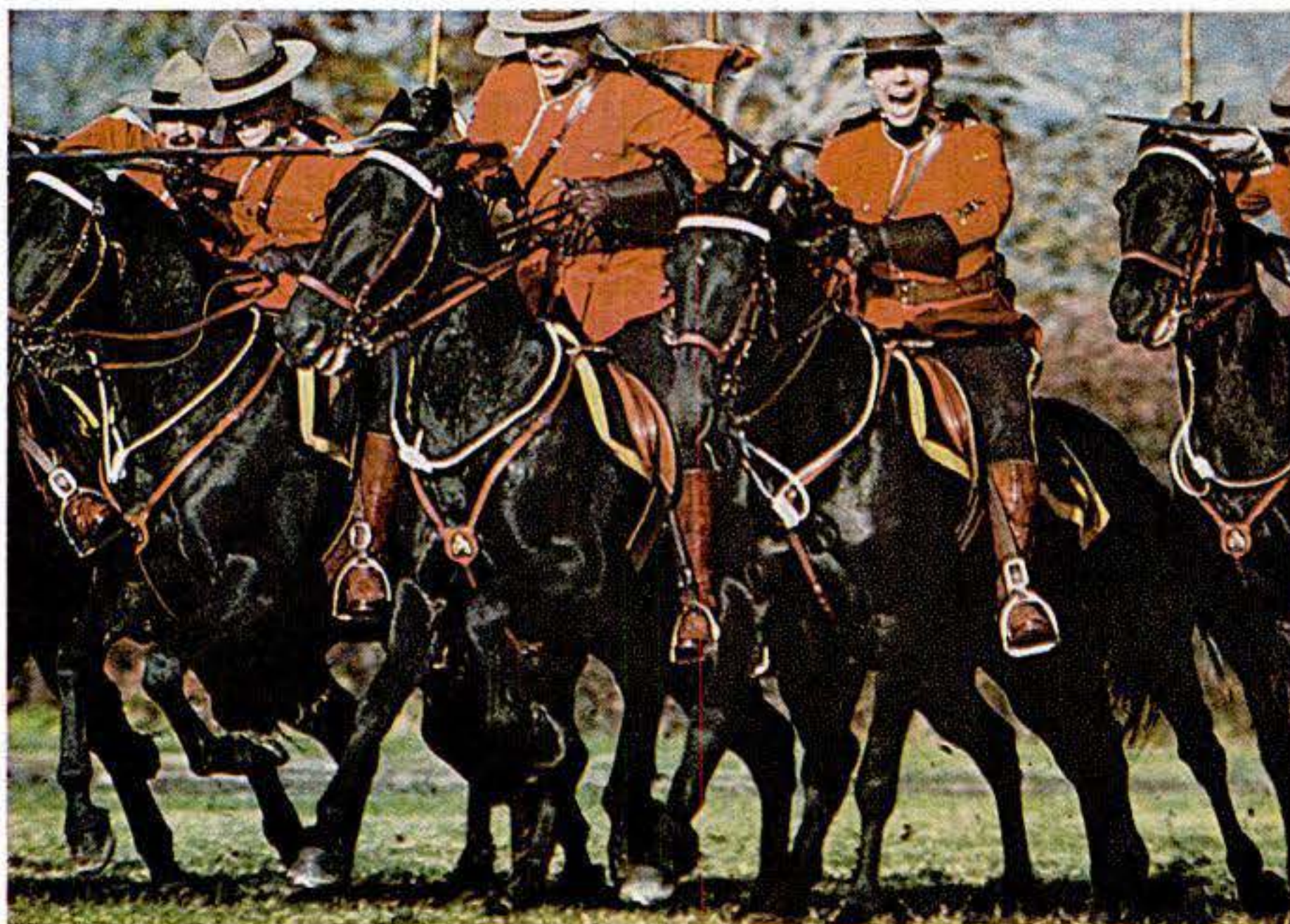
CBS Records is starting to use computer-controlled disc-cutting lathes for new recordings. Developed by the Columbia Technology Center in Stamford, Conn., the CBS DISComputer system adds up to five minutes more music per side, boosts recorded levels two to five dB, reduces noise, and cuts tracking and distortion problems, says CBS. The computer anticipates the width requirements of grooves, then widens or narrows them accordingly.

I tried two new discs cut with DISComputer, playing them with a remarkable new Shure phono cartridge (V15 Type IV) that I'll describe in an upcoming issue of PS. Both discs had excellent clarity and good dynamic range; with Koss E-9 headphones, a faint background hiss was audible on one side of CBS 34551 (Poulenc's *Gloria*). The Ramsey Lewis *Tequila Mockingbird* disc (CBS 35018) had barely perceptible hiss, despite the fact that the rhythm section was recorded in Chicago, then combined with horn and strings in New York.

For a comparison, I bought a European Philips recording of Weber and Cherubini symphonies (6500 154). I felt the Philips disc was at least equal in technical quality to DISComputer discs. The Philips recording had faint hiss equal to that on the Poulenc side of the CBS record. For another comparison, I tried a two-record, direct-to-disc album: Umbrella's *Big Band Jazz* (UMB-DD4). This limited-edition recording, with the master disc cut during one recording session (no tape involved), has no audible background hiss and the music has an electrifying presence because of its wide dynamic range.

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"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Crank-seal leaks

Here's the same problem on two identical cars. A friend and I each bought '77 Chevys with 305-cu.-in. engines in March '77. After approximately 1000 miles, both cars developed oil drips from the rear of the oil pan. After about 20 trips to the dealer, a talk with the factory rep, new oil-pan gaskets and three new oil pans, the lip of the oil pan still shows signs of leakage on both cars. Neither the bearing nor the oil seal was replaced. Any suggestions as to what is wrong or how to get Chevrolet to repair these cars?

Martin Laurer, Hicksville, N.Y.

I'll bet it's simply the rear crankshaft seal. I don't know how to get Chevy to pay for changing the seal. I get more and more puzzled every day by warranties and how they work on all makes, domestic and foreign.

I'd say that up to now there have been more chronic grippers than motorists who've been ripped off, but damned if I don't believe it's going the other way fast. It still amazes me how they mass-produce cars for the price they do (maybe I should say did) and make them as well as they do. But so often, now, something goes wrong and the dealer is flat lost.

Transmission is balky

I own a 1976 Scout II and a 1978 Scout Traveler. I've been using Mobil 1 in both engines with excellent results, even at -45° F. My problem is that whenever it is 10° or colder, I can't move the gearshift lever; the transmission oil turns to something thicker than fluid. Is there a synthetic for my T-332 and T-428 transmissions that will help my problem?

L. E. Smith, Elk Mound, Wisc.

Automatic-transmission fluid wouldn't be a bad try as far as synthetics go. I believe a good-quality one would work fine. Which one? I don't have enough dope to recommend one. But don't you play chemist. You could get in trouble in a hurry.

What gives the shakes?

I have a '77 Datsun 810 with automatic transmission (no power steering or air conditioner). With four adults in the car, there is a vibration that passes through the whole car when accelerating between 40 and 50 mph and when decelerating rapidly between 50 and 40 mph. The dealer has trued up the tires for roundness and balance,

and also changed the rear springs. The vibration seems to come from the rear and is not in the steering wheel. Can you suggest anything? The dealer seems stumped.

John J. Memolo, Moscow, Pa.

Balancing your driveline should get it if you can find someone with the equipment to do it.

When is it warmed up?

I recently bought a set of the *PS Home Owners Encyclopedia* and received a free copy of "Tips for the Handyman." One of the energy-saving tips says to "start the car moving as soon as possible. Few cars need more than a 30-second warmup." Do you believe this to be true?

Cliff Druliner, Scottsdale, Ariz.

Yes, but I'd like to qualify this by saying that, if you can, proceed with minimal power and rpm. And they say cars—not trucks or industrial equipment.

Lubrication technique

When I grease the front of my cars (a Chevy and a Pontiac), I drive onto a pair of portable car ramps. Recently, my neighbor told me I shouldn't use the ramps, but should jack the cars up so their suspensions will hang loose. This way the grease will go into the joints. When a car's weight is resting on the suspension (as it does on ramps), the grease just oozes around the joint, filling up the rubber dust boot. Is my neighbor right?

Stephen D. Cole, Tucker, Ga.

Yes—technically. But in practice I don't think there's that much difference.

Gremlin breaks manifolds

I have a 1976 Gremlin that has had four exhaust manifolds. Why can't I get one installed correctly? Is there a secret that we need to know or is this an intrinsic weakness with this car? I understand there have been considerable problems with 1976 Pacer exhaust manifolds.

Dr. Joel Halbert, San Antonio, Tex.

Four exhaust manifolds in two years comes definitely under the heading of an inherent problem, AAA rating. The fix will come from the factory or an extra-sharp mechanic who will fabricate a steel replacement and violate emission laws. This brings me to another point. We need a good small car made in this country so we aren't

forced to buy imports. It's 10 years late, already, and we still don't have one small car worth a damn.

Smokes and stalls

My 1975 Dasher wagon will be running normally, and then without warning it will miss, surge, and lose power. I look in the rear-view mirror and see a cloud of black smoke. All efforts (i.e. releasing, pumping, or depressing the accelerator, or shifting gears) have no effect. In one or two minutes, it stalls. After stopping, it will start in 30 to 60 seconds, and go quite a way before stalling again.

Three garages put in three sets of points, plugs, condensers, three carburetor kits, two catalytic converters, three ignition and three valve timings and have not solved the problem. After the last garage visit and \$106, I made it for 64 miles before the black smoke and stalling occurred. Help!!

Robert F. Dever, New Market, Va.

The black smoke is unburned gas. Your carburetor is very rich at that time. Find a carburetor man who can fix the problem that is causing your needle and seat and float to lose control of fuel level in the carburetor.

Hot Gremlin

I drive a 1977 AMC Gremlin with 18,000 miles on it. During the last month I have had two fires underneath the back seat. The metal beneath the seat is extremely hot when the car is brought to operating temperature, and has charred the carpet. The AMC dealer and factory representative say nothing is wrong. Any ideas? I need help.

James H. Sherrard, Houston, Tex.

Yes sir, I got an idea. There is a product called Grapoil, made by Union Carbide, that is the most effective heat barrier I've ever seen. Get some from an industrial-supply house, say about .02 thick. Cut, shape, and fit it to the hot area. Other thermal barriers could be placed inside or out, and you can make them from asbestos or aluminum metal plate. An air gap between the heat source and floor pan will help. No need to say what I think of what brought your problem about and what I think of the response you got.

Timing and mpg

In your December 1977 column, R. A. Wanner refers to retarding the distributor for improved mileage. I am under the impression that advancing the timing will improve both performance and mileage. Please clarify this point for me. My procedure for setting timing is to advance it to the point of spark knock and then retard slightly. Is this correct?

Wade D. Fletcher, Hartsville, S.C.

Wade, you're right, as long as you don't change the octane of the gas you're using. I went back and looked—

Continued

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FACTORY
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"Say, Smokey—"

[Continued]

there was an octane change involved. That part of the letter didn't get printed. As you go toward lower octane fuel you must slow down timing some. But the take-it-out-on-the-road-and-time-it days are about over, what with the complex timing systems of today. About all you can do if it pings is go back and recheck it. Detonation is still the same, though—bad news.

About bolt-on turbochargers

I have been reading a lot about turbocharging lately. I have a few questions about it, though. Does it really boost performance while increasing mileage, and if so, are there conversion kits available?

David Meyer, Burke, Va.

Turbocharging works and here's why: It takes wasted energy in the exhaust system and converts it to mechanical compressor energy. It ultimately improves the thermal efficiency by creating a much denser loading of fuel/air charge, which increases torque. There are conversion kits available but I don't recommend them. And I haven't seen one factory fuel system that I believe is ready for a bolt-on turbo. I believe a turbocharged engine needs to be designed from the ground up, which means it must be a rugged, normally aspirated engine with very good air-fuel distribution.

Cam belt slippage

Thanks for your fine advice in the past. During the last snow my '76 Rabbit went through some high snow and the engine died. I later found out the overhead camshaft belt slipped. VW fixed it and promised to put on an optional shield later. What is the chance of damaging valves in this case? The car runs fine now.

Jack D. Lauber, Latham, N.Y.

In most cars the chance of valve damage is excellent when the cam goes out of tune and the pistons hit open valves. The correct test for damage is an engine blow-down with a Sun cylinder leakage tester. If you bent a valve, it will show up loud and clear in the test.

Brakes lock up

My problem is with the brakes on my 1974 Duster. I need help badly before I wreck this car. When I apply the brakes the front wheels seem to lock. The back wheels don't seem to hold much. On ice I just can't control the car at all.

I took the car to the dealer twice. Each time it was all right for three months, and then the problem started again.

John J. Fostich, Sugar Creek, Mo.

Front-brake lockup usually means that the rear brakes are not working and/or

"Say, Smokey—"

[Continued]

that the front linings are too effective. My advice would be to have all the wheel cylinders and the master cylinder cleaned. Replace parts as necessary, and also check the master cylinder. Check all the valves in the system for clean, free operation. Front linings can be a problem if contaminated. If this is the problem, the only way to fix it is to change the front linings. I guess this sounds general and expensive and you'd like a short, cheap answer. But it's not that expensive, especially when your life is at stake. I can't be more specific about what parts you should check, since a mistake on my part could kill you.

Mysterious oil leak

I have a 1965 Chevelle with 327 engine that smokes and uses about one quart of oil every 350 miles. There is no visible oil leak. The engine emits bluish smoke, but only when I use full throttle over 4000 rpm. When the throttle is lifted, the smoking stops. Also, restarting the engine causes it to smoke for a minute.

I have rebuilt the engine twice using moly rings and two-piece gapless rings on the top grooves. Ring gaps were carefully checked and the cylinder walls were properly honed.

After the gapless rings were installed, the engine had very good power and did not smoke, but after 500 miles it lost some power and started to smoke slightly. Now the engine has 20,000 miles and is smoking more and also using more oil. The spark plugs are all clean with no visible signs of oil deposits. The heads have all new valves, guides, and seals. Cylinder leak-down tests showed all cylinders to have three- to five-percent leakage. The aluminum X-type manifold is well sealed to the heads.

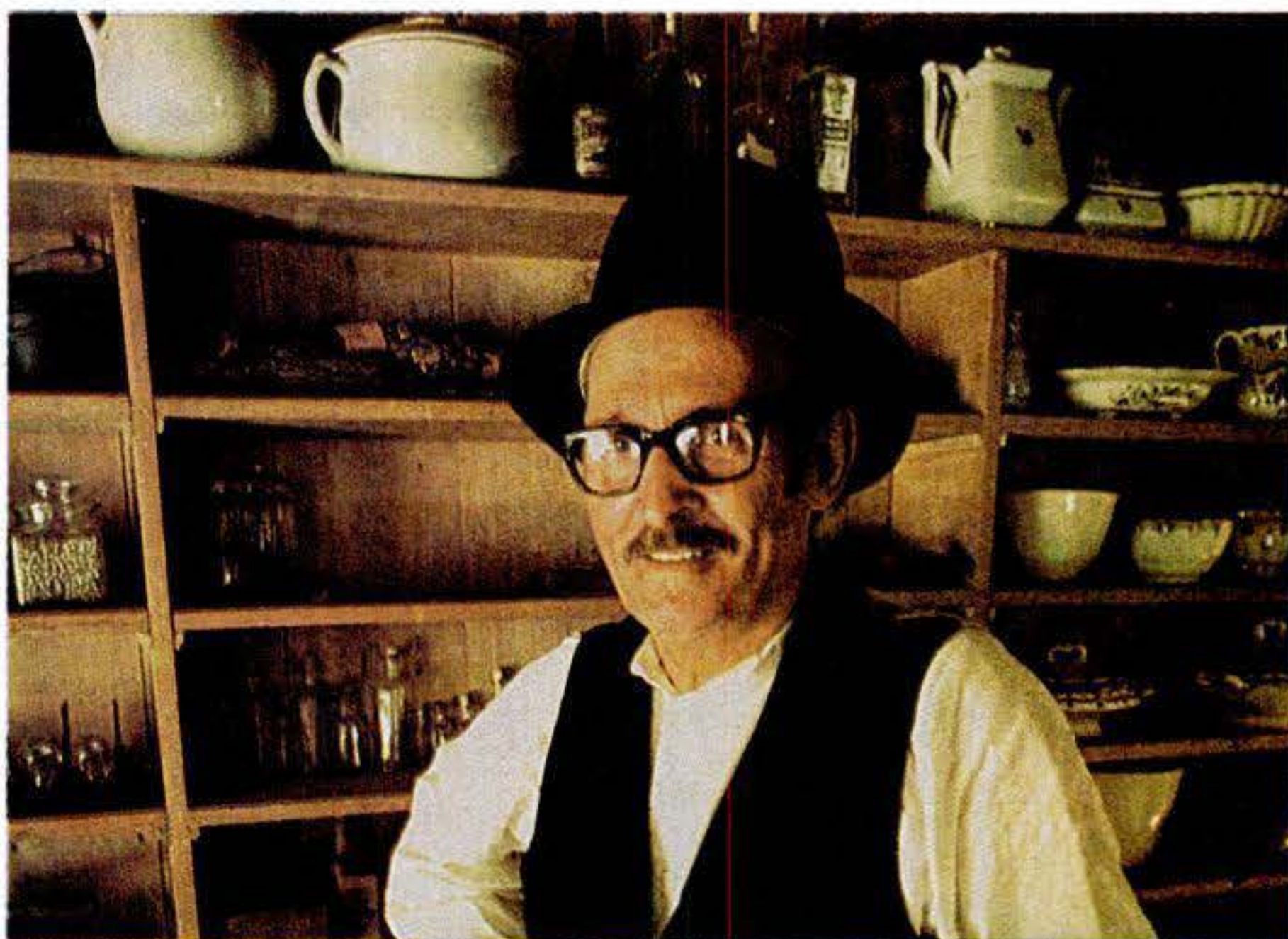
I use 10W-40 oil. Outside of oil usage and smoke, the engine runs well and gets up to 20 miles per gallon on the highway. Can you suggest a solution?

Robert Jucewic, No. Hollywood, Calif.

Look for a leaking intake port. This can happen in cylinder-head castings. I've seen it several times. More likely it is a leak in the intake-manifold casting. Everything sounds as if oil is being sucked into cylinders through the intake system.

Each month in *Popular Science* Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Send it to: "Say, Smokey—," *Popular Science*, 380 Madison Ave., New York 10017. Questions cannot be answered by mail.

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Computer add-ons

—kits you build for your home unit



Three kits let your unit communicate three ways

By WILLIAM J. HAWKINS
PHOTOS BY ORLANDO GUERRA

Even the smartest home computer isn't much more than a box of blinking lights if it can't communicate. For that, it needs accessories—peripherals, in computer jargon—that can translate digital bits of data into usable information.

I recently built and tested each of the three basic peripherals avail-

able in kits: a TV/terminal that lets the computer communicate with you; a paper punch/reader, which allows the computer to talk to itself by saving and retrieving programs on tape; and a modulator/demodulator that lets your system swap info with another computer—right over your home telephone.

TV/terminal

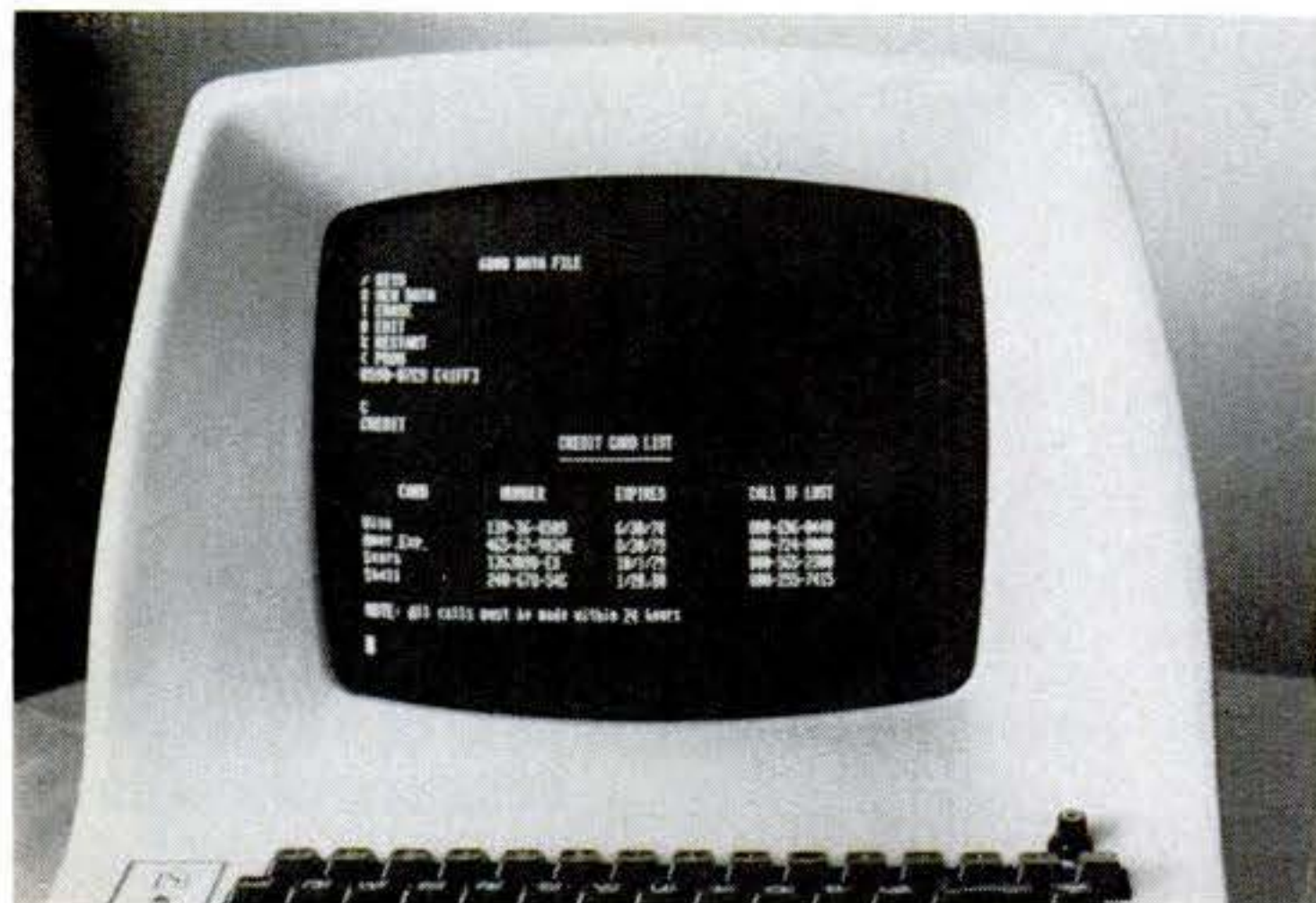
Naturally, it's most important that you and your system can communicate—and that's the job of

the Lear Siegler ADM-3 TV terminal. It's actually two units in one: a keyboard for typing data into the computer and a TV display to show what's coming out.

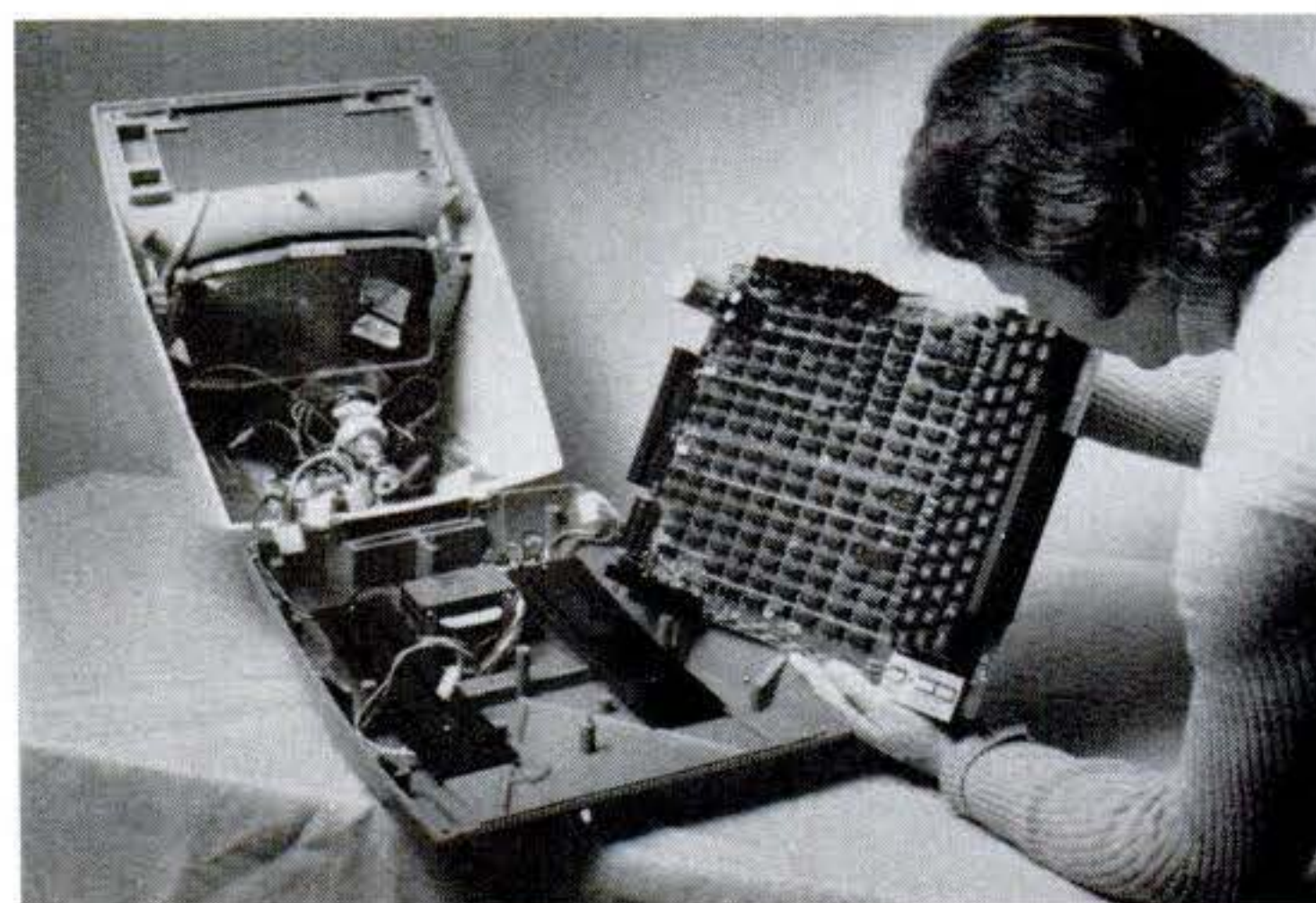
The TV and power-supply circuits come prebuilt and installed in the display shell. Your job for the next 12 hours: Fill the 12-by-18-inch main logic circuit board with parts, and solder well over 1000 component lead connections.

A spokesman for Lear Siegler told me the instructions were pur-

Continued



Display on the Lear Siegler is extremely clear, making it easy to read even during long periods of use. Lower-case letters can also be displayed, with \$75 optional IC package.



Hinged case swings up and out of the way for service or for access to selector switches. One-piece circuit board covers power supply and "beeper" speaker (end-of-line bell).

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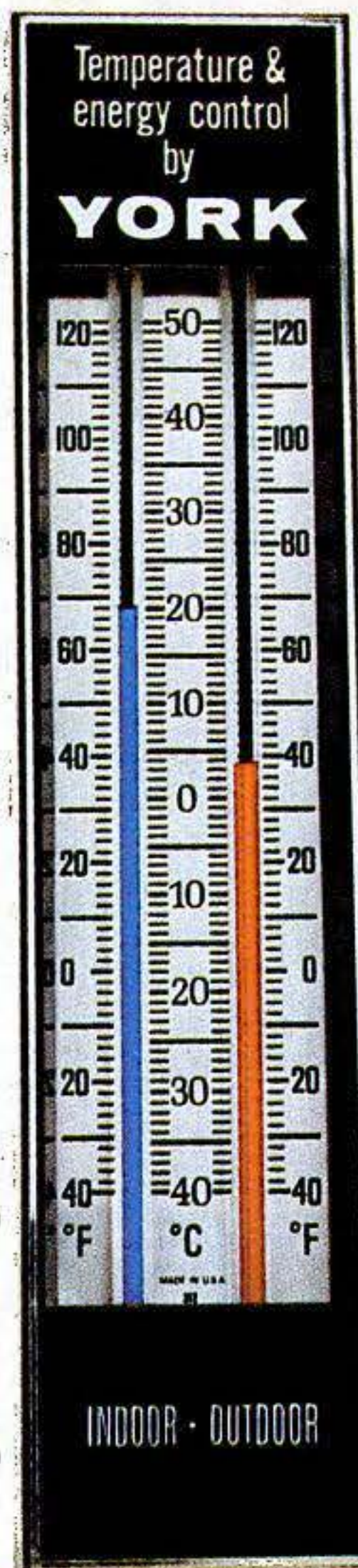
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whole-house air conditioner during the hot days and nights of summer. Second, send for your free copy of our new booklet "Energy & Your Home." Drawing upon leading authorities, this booklet gives you up-to-date information about all types of energy. It explains several heating and cooling options along with their advantages and disadvantages. It gives you advice on keeping your home comfortable while saving energy and operating costs.

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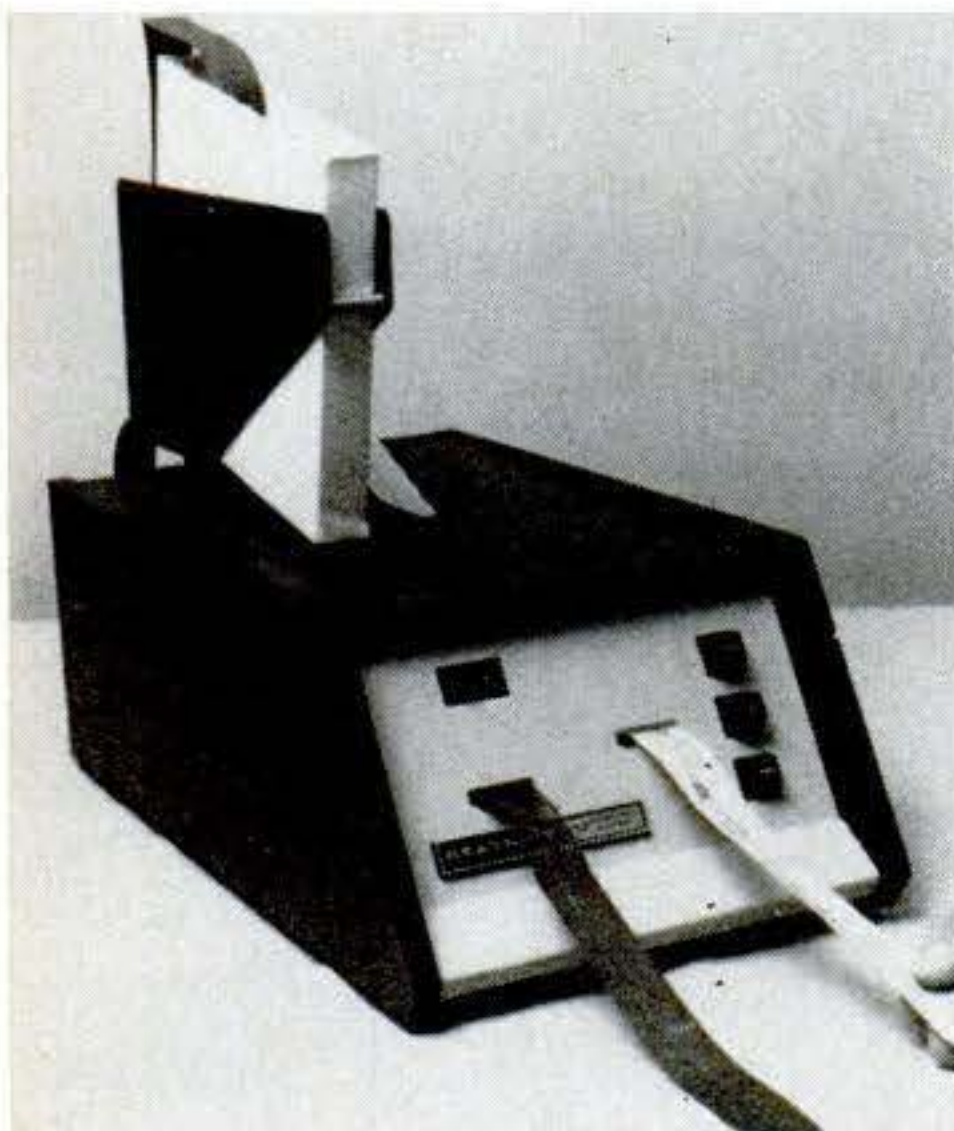
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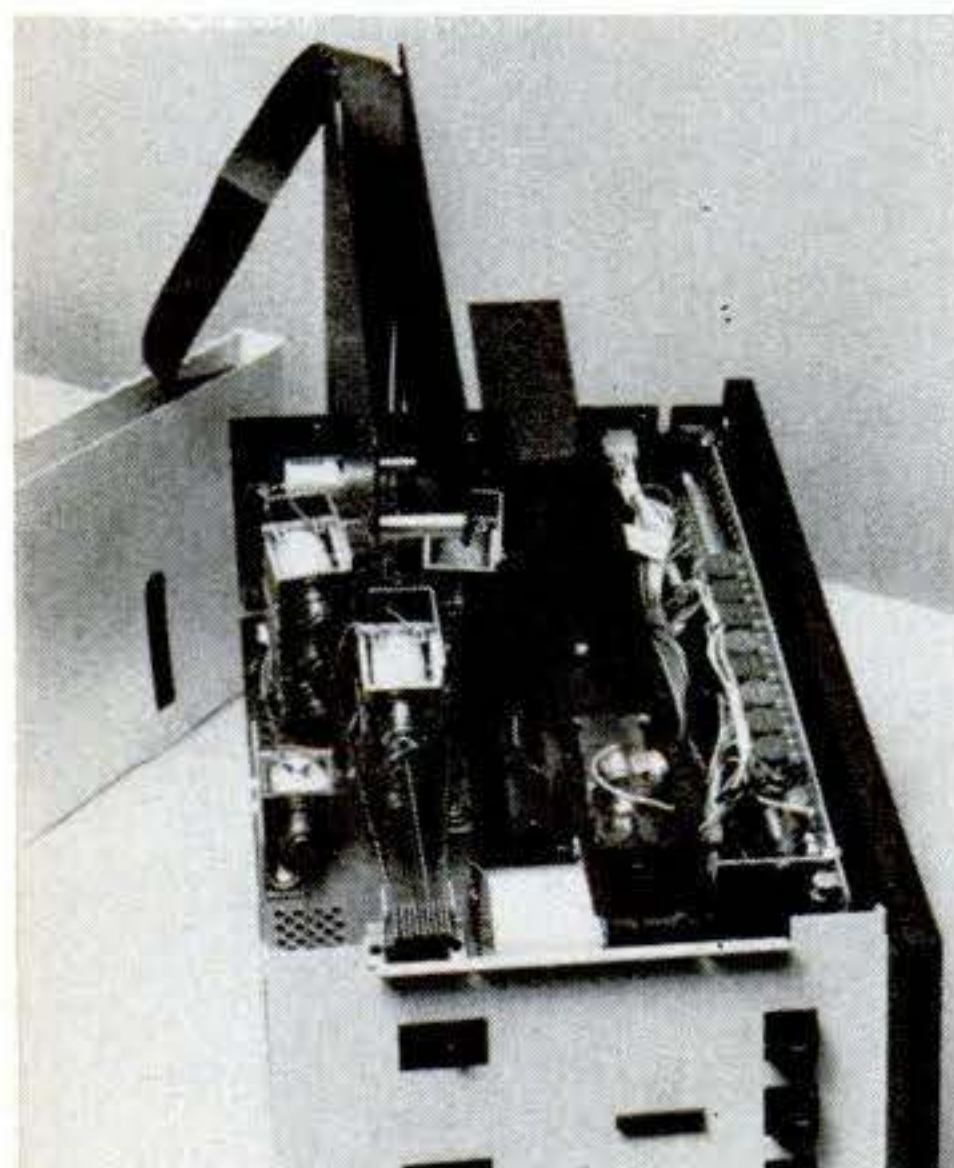
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[Continued]



Heath paper-tape punch/reader can be totally controlled by the computer or make copies of tapes on its own when rear-mounted button is pushed.



Tight fit: Circuit board, right, controls eight-level solenoid-driven punch. Optical reader assembly is below light bulb. Reader is motor-driven.

posely written to keep the challenge in kit building. They succeeded—the ADM isn't for the beginner. A new manual for the novice, however, is being prepared at the time of this writing.

The ADM is truly professional. The keyboard is ruggedly constructed and laid out as a standard typewriter for touch typists. It will produce all 128 standard character codes (ASCII) for the computer to read, and it gives instant cursor control if desired. (All modes, character display, and baud rates are switch-selectable on the main circuit board.)

The cursor is simply a white block or underscore line that appears on the TV screen to show where the next character will appear when typed. (Remember, there's no typewriter carriage to look at.) You can position the cursor anywhere on the ADM screen with the keyboard, or the computer can do so by using a special direct addressing mode.

The 12-inch screen displays 24 lines of 80 characters each and, when you fill the screen, the entire display scrolls up a line to make room for a new line at the bottom. And the display is clean—there's no pulling or out-of-focus characters anywhere, as I've seen on some terminals.

The ADM-3A is \$795 (kit) and \$895 (prebuilt) from Lear Siegler Inc., Electronic Instrumentation Div., Data Products, 714 N. Brookhurst St., Anaheim, Calif. 92803.

Punch it

It's rare to find a real deal in computer equipment, but Heath offers one with its H10 paper punch/reader. While just a reader

alone usually costs upwards of \$600, the Heath at \$350 will read and punch paper tapes for storing and retrieving programs.

Various combinations of tiny holes punched across a piece of paper tape represent specific computer numbers. By punching a series of these numbers down the length of the tape, the unit can permanently store an entire program. To read it back, the tape passes between photocells and a light source. When a hole goes by, light passes through to the cell and the computer registers the number.

If you can read, you can build the Heath punch/reader. The instructions and drawings are clear. Building time: two hours for the electronics, and 10 to 12 hours for the mechanical assembly.

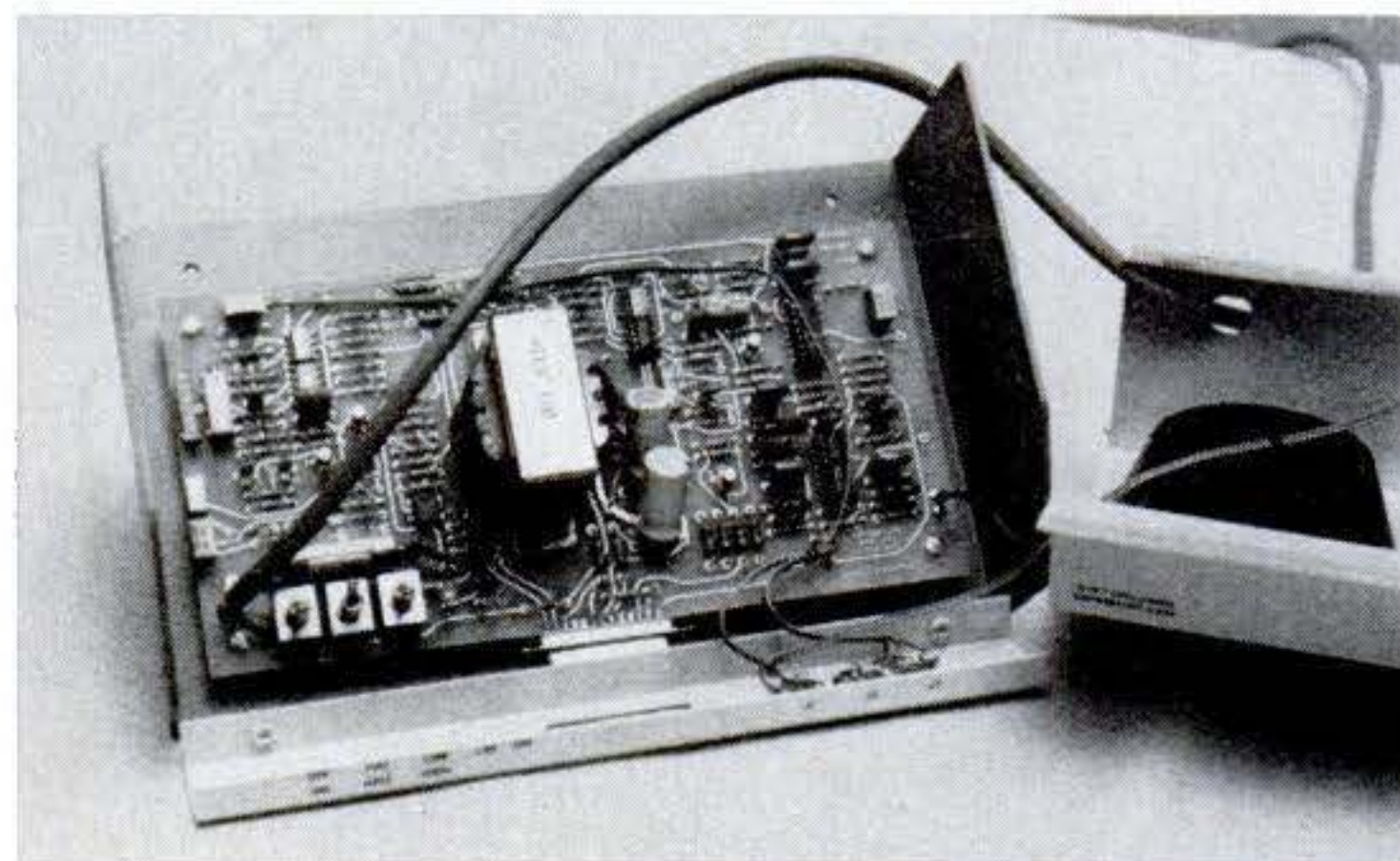
Once set up, the punch works well and the reader will accurately spot up to 50 characters per second (five times faster than conventional teletype readers). Tape copying is also easily done—just push a button.

Let me make two suggestions if you plan to use fanfold tape (which folds flat instead of winding). First, mount a small support (a bent piece of aluminum works fine) at the rear of the reader. Without it, the tape hangs over the back of the top tray in which it rests and can fall backwards from vibration. (Picking up a few hundred feet of *unfolded* fanfold tape is no fun, as I found out.) Secondly, place a small guide inside the front cover where the read tape exits. Occasionally, a fold on the tape will catch the edge of the rectangular hole, stopping the reader. I eliminated the problem in

Continued



Place a standard telephone handset in the acoustic-coupler top (rubber cups with two speakers inside), and the Penny-whistle modem will transmit or receive data.



On-board switches control one- or two-way transmissions as well as tone frequency for such tasks as getting through tone codes Bell Tel uses for long-distance calls.

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Computer add-ons

[Continued]

five minutes by sticking a small piece of adhesive-backed cardboard (a Polaroid back) to the top lip and extending it a half inch inside.

If you think that paper tape is dated when compared to magnetic tape or the disc systems available, you're wrong. It's slower, but at present it is more widely used to transfer information between computers. The H10 is an excellent buy and uses a standard eight-bit parallel interface (connection) to a computer. It's from Heath Co., Benton Harbor, Mich. 49022.

Hello?

The next time your phone rings, it could be a friend—or it could be your friend's computer using a modem like the Pennywhistle. A modem (modulator/demodulator) converts digital signals from your computer into tones (and vice versa) that can be sent over a phone line. The result: Your computer can send and receive programs or data to and from another computer anywhere in the country.

The possible uses for a modem are endless: You can swap programs with a friend, type letters or data directly on another remote TV terminal, or even tie into a central computer to teach your home unit new tricks.

The Pennywhistle modem is easy to build; about four hours of soldering components to a well-laid-out and -marked printed circuit board is most of the job. But you'll need a builder—or a friend—with the right test equipment: an oscilloscope or digital frequency counter, and an accurate AC meter for the initial calibration.

Connectors on the unit will give you a direct telephone connection if you don't want to rest the phone in the acoustic-coupler pads. You can also use the jacks to record the tones on a tape recorder, and then play it back later.

The Pennywhistle makes sounds all right—so I know it's working—but I haven't been able to give it a really good try. This is one case where being *second* on the block with something new—and having someone else to communicate with—is better than being first.

The Pennywhistle is \$129.95 (kit) and \$225 (assembled) from M&R Enterprises, Box 61011, Sunnyvale, Calif. 94088. It's compatible with all systems using RS-232 connections.

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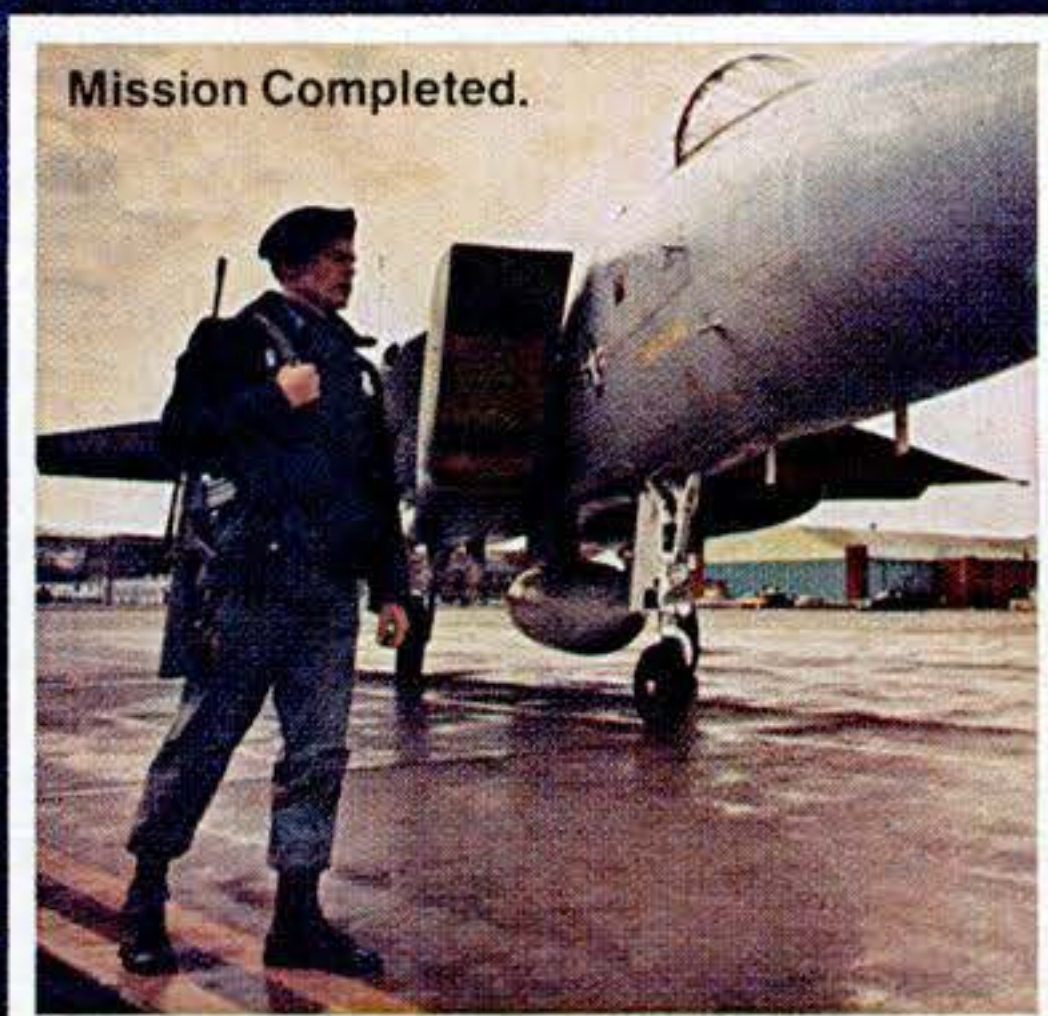
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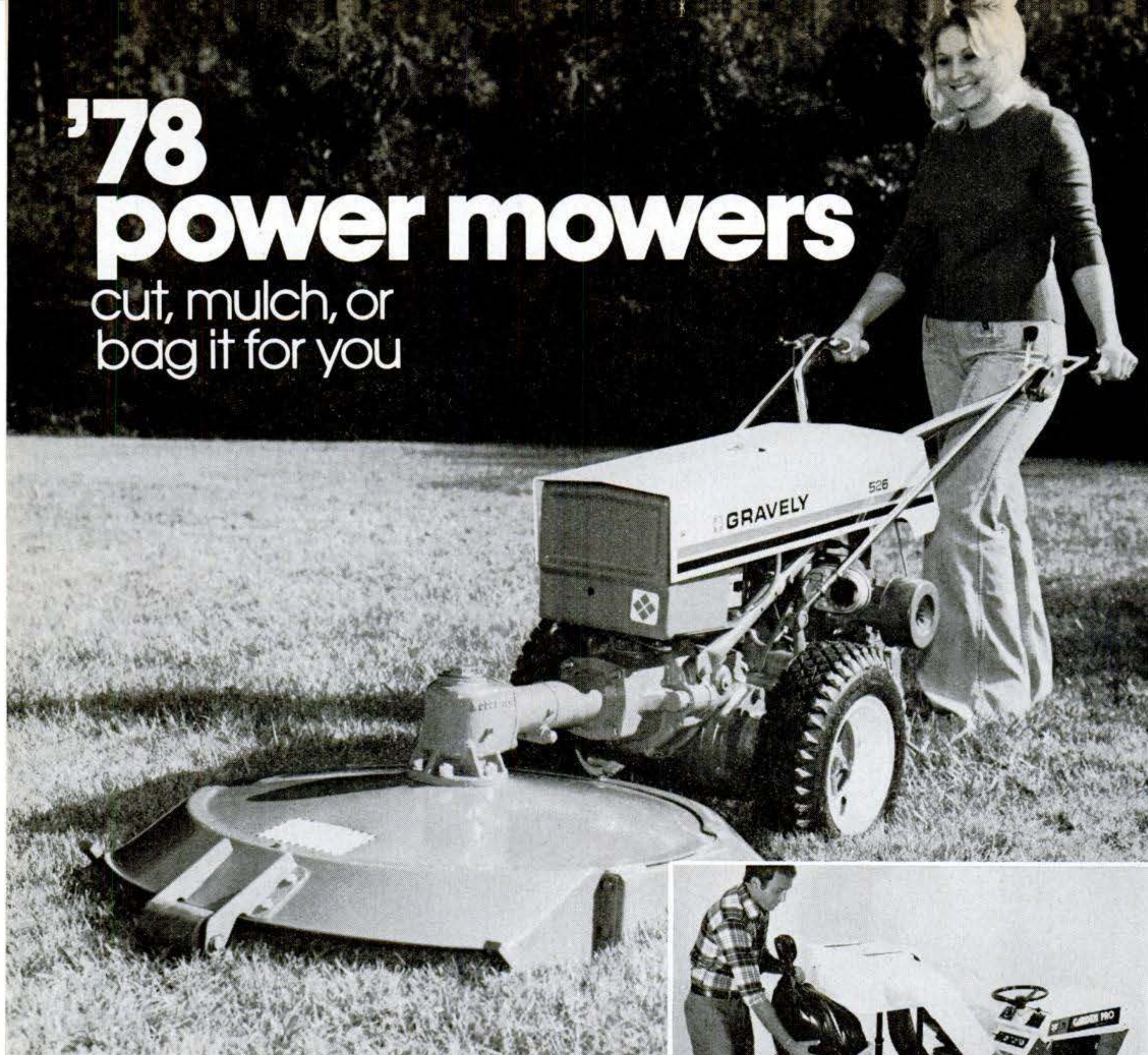
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AIR FORCE 

'78 power mowers

cut, mulch, or bag it for you



Clever features and more power should make the going a lot easier this summer

By E. F. LINDSLEY

Some refreshingly new ideas mark the '78 offerings in mowers and tractors. One happy trend is greater attention to real-life user needs and lawn-mowing problems. Examples:

- Baggers that discharge cuttings right into a plastic waste bag.
- 115-volt starting.
- Power burst for extra zip in tough going.
- More eight- and 10-hp riders for yards.
- More 11-hp lawn tractors that partially bridge the lawn/garden gap.
- A rash of mulching mowers.
- And more electric mowers with even self-propelled electric walkers.

Four forward speeds and reverse give you control of this eight-hp all-gear Gravely. At right, grass is separated from air stream and put in the bag by the Garden Pro tractor.



Electric mowers

The rechargeable battery mowers that you just plug in and forget until you're ready to mow again are about as convenient as any mower can be. True, they are limited to about 10,000 sq. ft. per charge, but that's plenty for many lawns. And there are the pluses: no starting problems, easy maintenance, and low noise. Even with big lawns these little battery outfits with 16-19-inch cut are handy for follow-up work where you can't cut with a rider or tractor. Look for Toro, Lawn-Boy, and Sears' new Hummer.

If you don't mind a power cord—and that's really no problem after a

little practice—there's almost no limit to the cutting area for an electric. This year, both Sears and Sunbeam have self-propelled cord electrics so you don't have to push. Sears also has a hand-push model, but the self-propelled mower has the edge since they're both rear baggers and tend to get heavy as the bag fills.

If you're looking for power and a much larger cutting area, Wheel Horse has two new electrics: the E-141 tractor with 42-inch cutter attachment, and the E-81 rider with a 32-inch cutting blade. Six batteries on the tractor give you a two-acre range—one 12-volt deep-discharge battery on the rider lets you cut as much as a one-acre lot be-

Continued



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WITH WHAT MINOLTA KNOWS ABOUT CAMERAS AND WHAT YOU KNOW ABOUT YOURSELF, WE CAN MAKE BEAUTIFUL PICTURES TOGETHER.

If you've considered buying a 35mm single lens reflex camera, you may have wondered how to find the right one out of the bewildering array of models and features available.

And with good reason, since the camera you choose will have a lot to do with how creative and rewarding your photography will be.

What you pay for your camera shouldn't be your only consideration, especially since there are some very expensive cameras that won't give you some of the features you really need. So ask yourself how you'll be using the camera and what kind of pictures you'll be taking. Your answers could save a lot of money.

How automatic should your camera be?

Basically, there are two kinds of automatic 35mm SLR's. Both use advanced electronics to give you perfectly exposed pictures with point, focus and shoot simplicity. The difference is in creative control.

For landscapes, still lifes, portraits and the like, you'll want an *aperture-priority* camera. It lets you set the lens opening, while it sets the

shutter speed automatically.

This way, you control depth-of-field. That's the area of sharpness in front of and behind your subject. Many pro photographers believe that depth-of-field is the most important factor in creative photography.

At times you may want to control the motion of your subject. You can do this with an aperture-priority camera by changing the lens opening until the camera sets the shutter speed necessary to freeze or blur a moving subject. Or you can use a *shutter-priority* camera, on which you set the shutter speed first and the camera sets the lens automatically.

Minolta makes both types of automatic camera. The Minolta XG-7 is moderately priced and offers aperture-priority automation, plus fully manual control. The Minolta XD-11 is somewhat more expensive, but it's the world's only 35mm SLR with both aperture and shutter-priority automation, plus full manual control.

The XD-11 is so advanced that during

shutter-priority operation it will actually make exposure corrections you fail to make.

Do you really need an automatic camera?

Automation makes fine photography easier. But if you do some of the work yourself, you can save a lot of money and get pictures every bit as good.

In this case, you might consider a Minolta SR-T. These are semi-automatic cameras. They have built-in, through-the-lens metering systems that tell you exactly how to set the lens and shutter for perfect exposure. You just align two indicators in the viewfinder.

What to expect when you look into the camera's viewfinder.

The finder should give you a clear, bright view of your subject. Not just in the center, but even along the edges and in the corners. Minolta SLR's have bright finders, so that composing and focusing are effortless, even in dim light. And focusing aids in Minolta

Minolta makes all kinds of 35mm SLR's, so our main concern is that you get exactly the right camera for your needs. Whether that means the Minolta XD-11, the most advanced camera in the world. Or the easy-to-use and moderately priced Minolta XG-7. Or the very economical Minolta SR-T cameras.





Automatic sequence photography is easy when you combine a Minolta XD-11 or XG-7 with optional Auto Winder and Electroflash 200X.

viewfinders make it easy to take critically sharp pictures.

Information is another thing you can expect to find in a well-designed finder. Everything you need to know for a perfect picture is right there in a Minolta finder.

In the Minolta XD-11 and XG-7, red light emitting diodes tell you what lens opening or shutter speed is being set automatically and warn against under or over-exposure. In Minolta SR-T cameras, two pointers come together as you adjust the lens and shutter for correct exposure.

Do you need an auto winder?

You do if you like the idea of sequence photography, or simply want the luxury of power assisted film advancing. Minolta auto winders will advance one picture at a time, or continuously at about two per second. With advantages not found in others, like up to 50% more pictures with a set of batteries and easy attachment to the camera without removing any caps. Optional auto winders are available for both the Minolta XD-11 and XG-7, but not for Minolta SR-T cameras.

How about electronic flash?

An automatic electronic flash can be added to any Minolta SLR for easy, just about foolproof indoor photography without the bother of flashbulbs. For the XD-11 and XG-7, Minolta makes the Auto Electroflash 200X. It sets itself automatically for flash exposure, and it sets the camera automatically for use with flash. An LED in the viewfinder signals when the 200X is ready to fire. Most

unusual: the Auto Electroflash 200X can fire continuously in perfect synchronization with Minolta auto winders. Imagine being able to take a sequence of 36 flash pictures without ever taking your finger off the button.

You should be comfortable with your camera.

The way a camera feels in your hands can make a big difference in the way you take pictures.

The Minolta XD-11 and XG-7, for instance, are compact, but not cramped. Lightweight, but with a solid feeling of quality. Oversized controls are positioned so that your fingers fall naturally into place. And their electronically controlled shutters are incredibly smooth and quiet.

Minolta SR-T's give you the heft and weight of a slightly larger camera, but with no sacrifice in handling convenience. As in all Minolta SLR's, "human engineering" insures smooth, effortless operation.

Are extra features important?

If you use them, there are a lot of extras that can make your photography more creative and convenient. Depending on the Minolta model you choose, you can get: multiple exposures with pushbutton ease

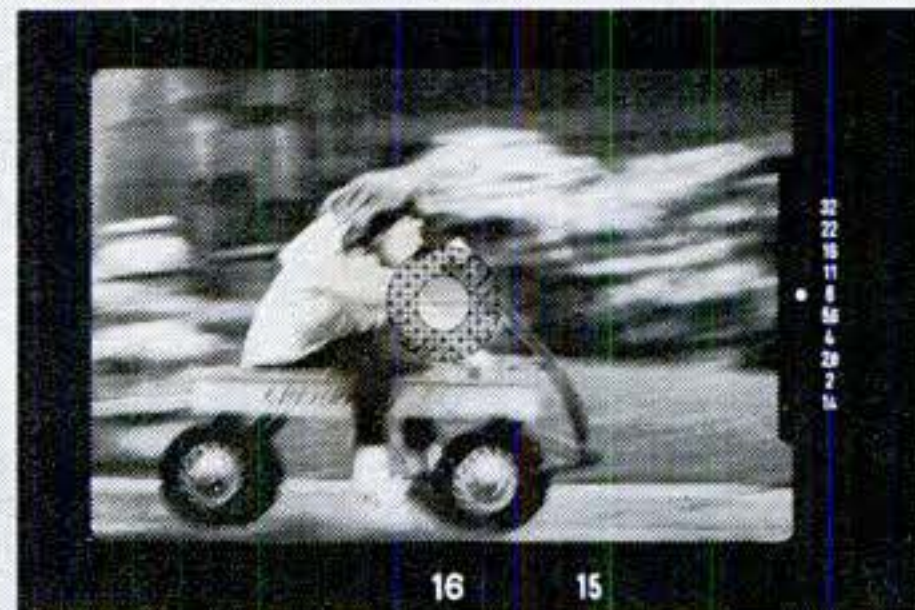


(even with an auto winder). A window to show that film is advancing properly. A handy memo holder that holds the end of a film box to remind you of what film you're using. And a self-timer.

What about the lens system?

The SLR you buy should have a system of lenses big enough to satisfy your needs, not only today, but five years from today.

The patented Minolta bayonet mount lets you change lenses with less than a quarter turn. There are almost 40 Minolta lenses available, ranging from 7.5mm fisheye to 1600mm super-telephoto, including macro and zoom lenses and the world's smallest 500mm lens.



The electronic viewfinder: LED's tell you what the camera is doing automatically to give you correct exposure.



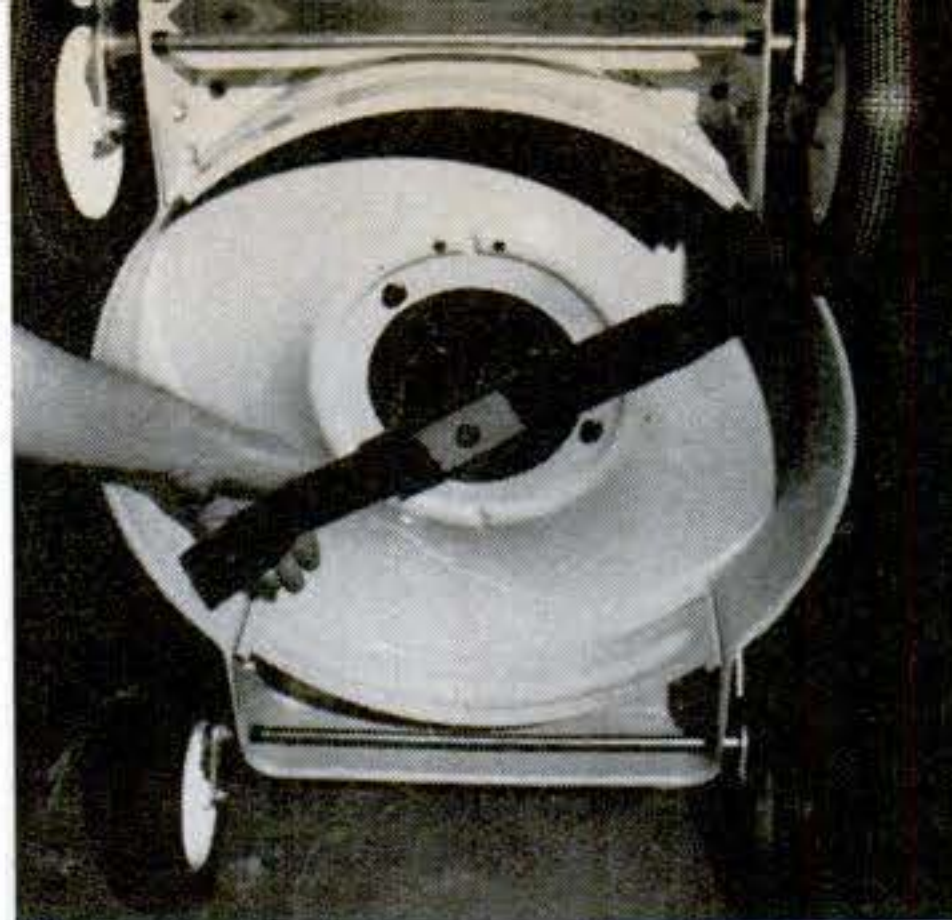
The match-needle viewfinder: just align two indicators for correct exposure. Because you're doing some of the work, you can save some money.

What's next?

Think about how you'll use your camera and ask your photo dealer to let you try a Minolta. Compare it with other cameras in its price range. You'll soon see why more Americans buy Minolta than any other brand of SLR. For literature, write Minolta Corp., 101 Williams Drive, Ramsey, New Jersey 07446. In Canada: Minolta Camera (Canada) Inc., Ontario. Specifications subject to change without notice.

MINOLTA

WE WANT YOU TO HAVE THE RIGHT CAMERA.



Mulching mowers, such as this Atlas, have no discharge chute. A deep bowl and special blade recirculate cuttings.

Top control lever on J.C. Penney mulcher (left) easily and safely adjusts all wheel heights. It's cable-connected.



Self-propelled Maxi-Mow from Sears ejects directly into trash bag. It has five forward speeds.

fore it is necessary to recharge.

Electric start

Although electric-start mowers with small battery packs have been around for some years, their limited cranking power has sometimes been a problem. Admittedly, if you keep your mower engine in reasonable shape, it will start on the first or second pull anyway; but some users just don't have the muscle or the knack for starting engines. That's why Sears' new 110-volt self-starting mowers will be popular. One model is a 20-inch push type, the other is a 22-inch self-propelled; both have the same two-speed 3.5-hp engine.

To start, you just plug into a wall socket and push the button. Pulling a starter rope is one of those real-life problems we mentioned earlier, and for persons with physical problems the 115-volt starters are an excellent choice.

Mulching mowers

Bolens, originators of the Mulching Mower, apparently has won its point that mulching really does save raking and bagging, and does, indeed, feed very fine clippings down into the grass-root area as

fertilizer. This year, Bolens expanded its line of walk-behind mulchers to eight models ranging from a three-hp, 18-inch two-stroke, to a five-hp, 22-inch four-stroke, with power-propelled and electric starting options.

Meanwhile, Toro says that three of every five buyers of walk-behind mowers will look at a mulching mower first. They're offering three new ones, all 21-inch cut, one with power drive. Other mulchers to look at: Simplicity with a 21-inch cut and eight-inch steel wheels; Jacobsen with three twin-blade 20-inches, two self-propelled and one with electric starting; Atlas and J.C. Penney with 21-inch, 3.5-hp hand-push models. This J.C. Penney mower has a unique console lever control that lets you adjust cutting height instantly on all four wheels. More than convenient, this should be a fine safety feature.

Rear baggers

The day of the awkward side-baggers seems to be passing. For '78 a number of new rear baggers tend to make them obsolete. Sears' 22-inch self-propelled Maxi-Mow is the most sophisticated. The clippings go directly into a plastic trash bag in a

between-the-handles hopper. You just twist-wire the bag top and lift it out. Also unusual, the Maxi-Mow has a five-speed transmission, ideal for reducing mower fight whether you want to creep, crawl, or pace. A less costly Sears rear bagger uses a conventional bag, is a pusher, but has whopping big 12-inch rear wheels to ease the push as the bag fills.

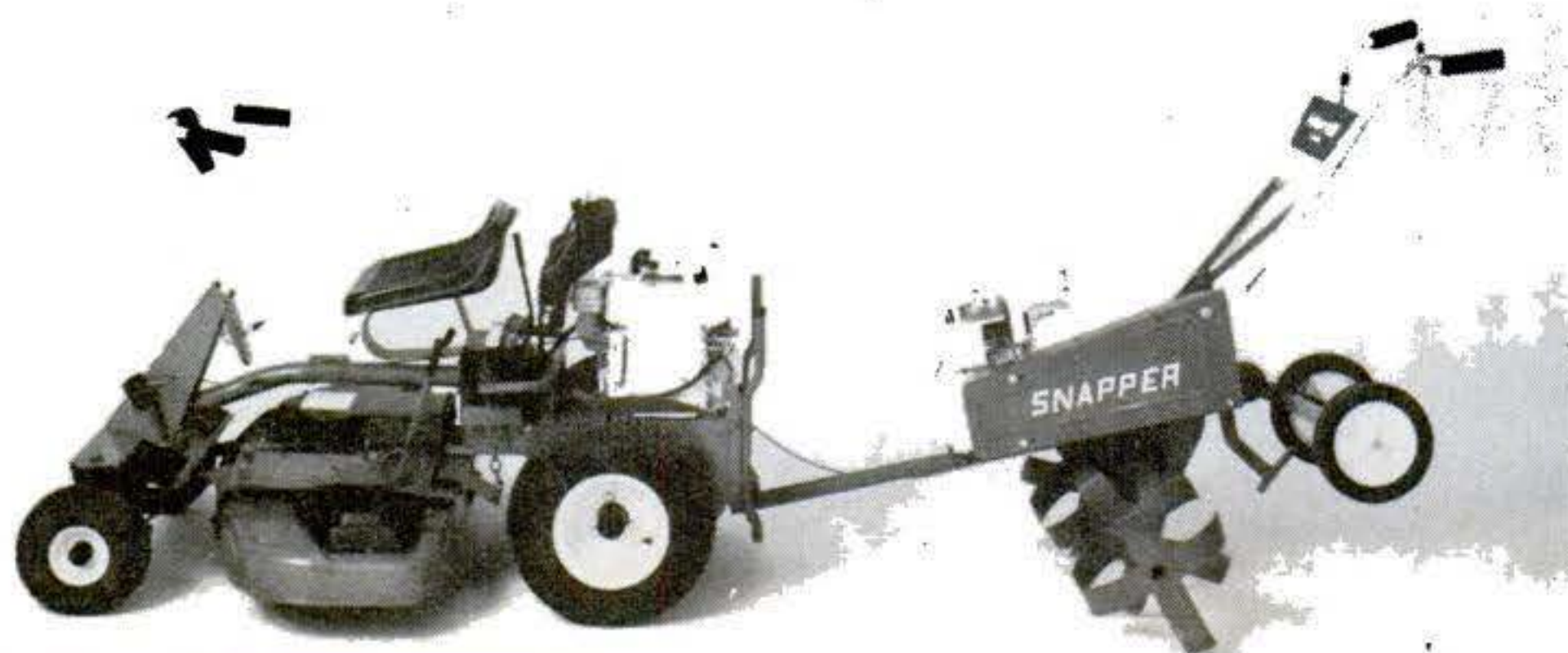
Another top-notch rear bagger (optional), from John Deere, comes with four hp, 21-inch cut, and steel ball-bearing wheels (the rear set is nine-inch-diameter). Rear power drive has always given best traction and that's very important when carrying the added weight of grass clippings. The Deere 21SP has bevel-gear, rear-wheel drive with a ratcheting feature that acts as a differential to let you swing the front end around easily.

Not every lawn has the space to sneak big bagging mowers through the garden gates, and not everyone feels at ease handling a big and heavy machine. Toro has trimmed weight in its five-model rear-bagger line, and the lightest and trimmest is a push-type 18-incher weighing only 50 pounds. At the wider end

Continued

Hitch kit on the Snapper turns this mower into a real workhorse. You ride while the tiller is pulled behind.

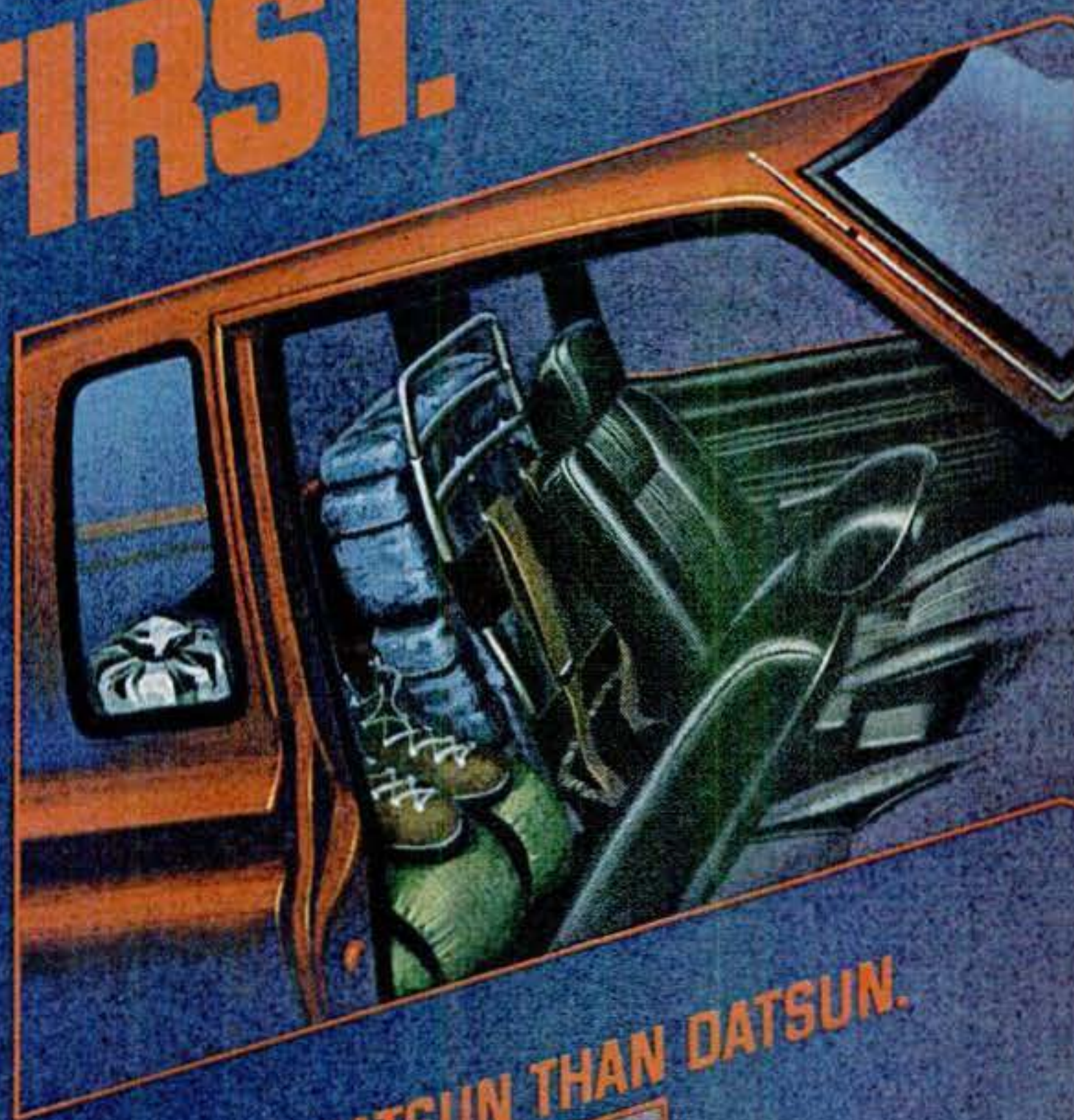
Allis-Chalmers 611 (right) cuts grass, clears snow, bulldozes. Its 11-hp engine powers either a lawn or garden tractor.





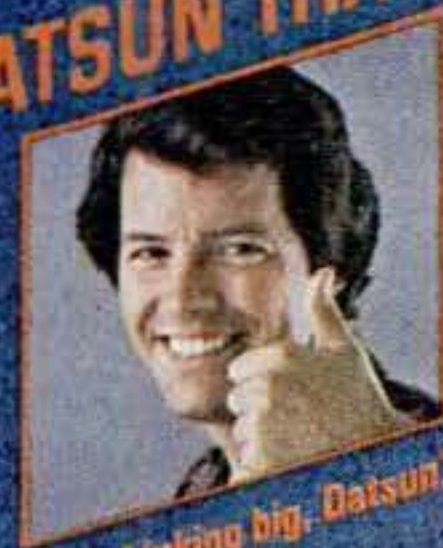
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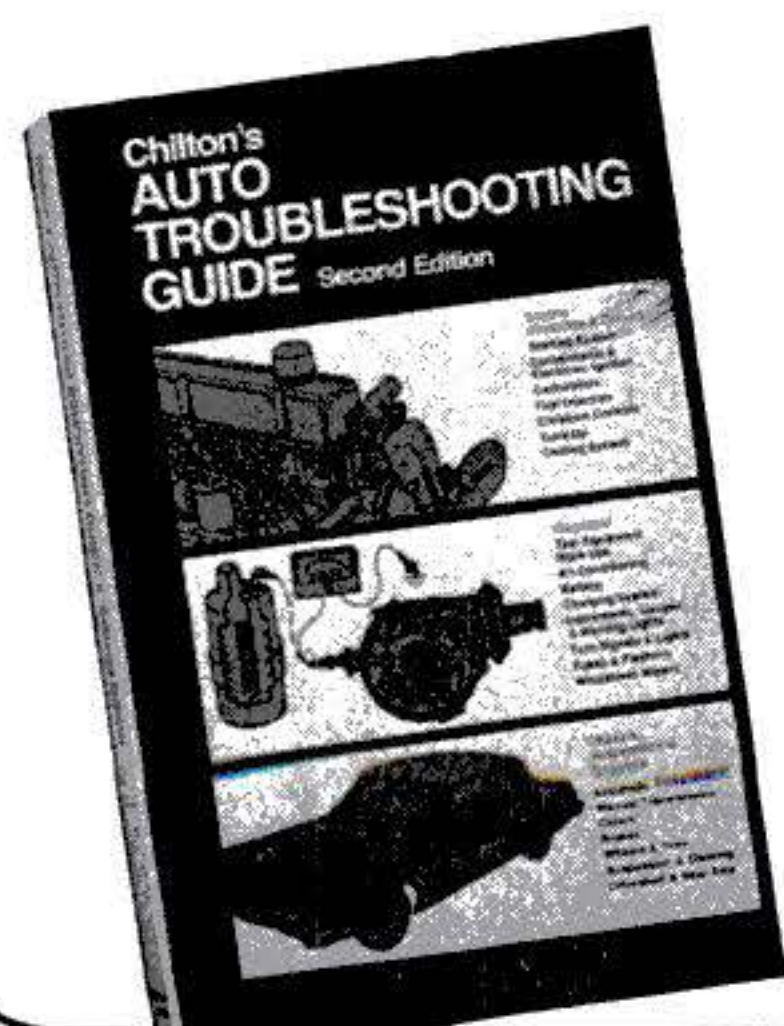
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After all, before you can fix what's wrong with your car, you have to know what's wrong with your car.

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of the line they have 21-inch mowers with self-propel and electric-start options.

The Power Burst is an outstanding feature on Jacobsen's new 20-inch push or self-propelled models. For normal cutting you breeze along at normal power, but, if you get into heavy going, a push on the Power Burst handle will gun the engine somewhat like kicking your car into passing gear.

More power

If you have a thick, heavy lawn or tall and weedy grass, you may be more interested in power and durability than in fancy details. Clinton Engine Corp. has just introduced a pair of heavy-duty, two-cycle 20- and 22-inch hand-push rotaries with 5.5 hp. The engine has ball-and-needle bearings, the wheels are ball bearing, and the blade drives through a heavy-duty clutch.

If you really want to challenge a jungle, or simply want a solid lifetime mower, look at Gravely's eight-hp, four-speed, all-gear drive Model 5260 with electric start and a 30-inch front-mount cutter. The 5260 will also drive a snow-thrasher, rotary plow, or rotary cultivator.

More at the consumer end of the line, Lawn-Boy has announced a revised engine with 20 to 30 percent more power and more displacement, plus a new one-piece, air-vane governor integrated into the carburetor for quick, direct response. The basic Lawn-Boy contours and quietness are the same, as is the solid-state capacitor ignition, but performance has been boosted substantially.

Riders

The distinction between a lawn tractor and a riding mower has become more blurred. Toro's "front-engine riders" look like very handsome tractors, offer eight, 10, or 11 hp, five-speed transaxles, and friction-plate clutches. The eight- and 10-hp models have a single blade, 32-inch cut; the 11-hp has a three-blade, 42-inch deck. The eight- and 10-hp Toros offer a 2 $\frac{3}{4}$ -bushel lever-dump grass catcher, but the 11-hp does not (it's intended for big lawns where that feature is impractical).

Distinctly a front-reach rider and designed in typically Ariens businesslike fashion with sturdy controls and massive tires, a new 10-hp Ariens is bound to please those rider fans who need high power. If you have hills and heavy



Self-propelled 22-inch Bolens Mulching Mower not only cuts grass into fine bits, but removes leaves the same way.

grass, and like the smooth speed changes of Ariens disk drive, this mower with either a 30- or 38-inch deck is a good bet. Also attractive for those who want power plus the much better durability of a larger engine is John Deere's 68 rider mower with eight hp, five-speed on-the-go shifting, and a tilt-up fiberglass engine housing. You can get either a 30-inch single-blade deck or a 34-inch twin-blade deck. The latter doesn't use a bagger.

Long noted for rugged durability, Snapper has a new model with a 25-inch deck and 29-inch-wide chassis that should be a dandy for people with a limited area and a lot of narrow, tight places to snake through. A new 42-inch-cut Snapper is also available.

One-piece, all-steel construction from Wheel Horse offers dependability in new five- and eight-hp riders. The A-51 is a 32-inch side-discharge mower, and the higher-powered A-81 is a 36-inch rear-discharge rig. At your disposal: five forward speeds and reverse in a straight-line shift pattern for easy use.

Tractors

After some status-quo years, tractor powers are up slightly in the low and middle ranges. Expect to see 11 hp as a common dividing point between lawn and garden tractors. At 11 hp you can have some of both worlds. An example is the Bolens G11 XL and H11 XL pair. One has gear drive and the other has hydro drive, but both are very able for such jobs as snow removal and grass cutting. You'll find the same capabilities in the new 11-hp Simplicity Regent lawn tractor, but take note—Simplicity also has an 11-hp Broadmoor garden tractor that takes a 42-inch

mower and has other features the Regent doesn't. Both are gear-drive.

Comparable models but with different options also appear in the John Deere line. The eight-hp Model 100, with three speeds and a quiet, enclosed engine is an economical 34-inch lawn cutter. But Model 208, also eight-hp, has a cast-iron engine, battery ignition, four-speed gears, 3.5-gallon gas tank, weighs 114 pounds more, has bigger tires, optional lights and electric shift, takes a 38-inch mower, and will handle a tiller.

Another power mix pops up in Gilson's 11-hp lawn tractor (also offered as an eight-hp) with a three-speed transmission, and its 11-hp lawn and garden tractor with a synchro-balanced engine, four-speed gears, and a provision for rear discharge.

Allis-Chalmers also has an 11-hp in-between tractor, Model 611 LT, with a three-speed transaxle, front and center PTO, and capability for a 36-inch mower or a snowthrower.

Most novel of the 11-hp fleet would have to be Garden Pro's Bagger Upper. Basically, it's a 38-inch-cut lawn tractor with a five-speed transaxle. But a unique up-and-over grass pickup separates



A tractor? Nope, it's a front-engine rider from Toro. The 11-hp cutter is made to cover big lawns in a hurry.

Lawn-Boy (left) gets more power and quicker response from a bigger engine displacement and new governor system.

out cuttings and dumps them in a standard plastic garbage bag. The bag rides in a wheeled trailer much like an oversize laundry hamper.

At the top of the power packages, Gravely, long king-of-the-hill in amazingly solid, all-gear drive tractors, has two new eight-speed jobs, both with twin-cylinder Onan engines. If these won't handle your lawn it offers another new super tractor, the GMT 900, which features a four-cylinder, water-

cooled engine and 72-inch deck.

Not far behind is an 18-hp newcomer from Ariens, a hydro drive with a single-cylinder, overhead valve engine. The rear PTO is electrically controlled. Gilson is also in the race with a 16-hp twin carrying a rear-discharge mower.

And Wheel Horse adds more power to its C-series tractors with two new 16-hp models: an eight-speed manual and an automatic-transmission model. **PS**

SNAPPER FAST.



There's only one way to finish your lawn Snapper fast. And that's with a Snapper mower. You can choose one of our V-Series mowers. Or the famous Snapper Comet. Or the new "High Vacuum" Riding Mower with the

optional Bag-N-Wagon that holds 30 bushels. All of them are designed to help you finish your lawn Snapper fast. So that you can spend more time doing what you want to do.

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McDonough Power Equipment, Inc., Dept. PS-71, McDonough, Georgia 30253. A Fuqua Industry. See your Yellow Pages or write for a free brochure. All Snapper mowers meet A.N.S.I. safety specifications.

Bonnie and Clyde led us on a wild chase to the site of their last known hideout.

Nearby we hid a case of Canadian Club.

It had been 44 years since Bonnie Parker and Clyde Barrow sped through this northern Louisiana wilderness on their last run from the law. Tracking their legend even now is a wild and wooly chase over lonesome red clay roads which run deep in tangled pine forests.

We met folks who'd seen them.

Finally our search led to where an old squatter's cabin had once stood. Bonnie and Clyde were known to have holed up here in their last days, and local folks told us they'd seen the two lurking hereabout back in '34. So having found the long-lost hideout, we trekked into the brush and buried a case of Canadian Club.

Start at "the end of the trail."

To find that C.C., start your trail exactly where Bonnie and Clyde's ended. Find the road they took to their fateful rendezvous with the law – and head in the opposite direction, all the way to



the next parish. Go past the "three R's" place, and where David's lad abides, turn onto a red dirt road. At the black gold storage place, head north. **Look for a warning.** Two hard left turns and a short drive will bring you to an old sawmill. Continue till you are warned about digging and stop (if you're warned more than once, you've gone too far). On your right is an overgrown trail. Follow it to two former money-makers. From one of them, take a bearing of 160 degrees, and take a pace for each of the 120 years people have been enjoying Canadian Club. Now take 44 more in any direction but the one you've come from to where three stumps form a triangle.

We hope you brought ice and glasses, for within that triangle, just one foot down, lie 12 bottles of the world's finest tasting whisky. But if the rigors of the hunt seem too great, you can find the same great taste at your favorite tavern or package store by simply saying, "C.C., please."



Bonnie and Clyde.



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PS | What's News

How do you make a photograph to show slipperiness? That's the challenge we tossed to photographer George Leavens for this month's cover illustration of super-slippery oils. George tried every trick he and we could think of but none of his beautifully composed and lighted transparencies quite got the message across until he came up with that action that is instinctive with all of us who spend any time around machinery. Can you resist the impulse to feel with your fingers any substance you are told is super-slippery? In the course of writing his article, Al Lindsley talked to researchers at most of the major lubricating-oil producers as well as a number of independent experts. He found only two brands of super-slippery oil on the market, but as we go to press several other makers are developing similar products. We are convinced by the tests and research we have seen that these are valid new products and not just an advertising gimmick. You can judge for yourself when you read Lindsley's story starting on page 46.

Lift translator exceeds expectations

The working model of Dr. Schneider's lift translator, the subject of our cover for February '78, has been in operation for the past three weeks at this writing.

Tests of the 1/25-scale model at the Hydraulic Laboratory of the University of California at Davis show an efficiency of 80 percent—substantially better than expected. Monitoring the electrical output of this scale-model low-head hydroelectric application shows that it develops enough electric power to run a three-hp motor. The plans are to install a full-scale device in a canal in the Turlock (Calif.) Irrigation District.

Heat from an ice cube

That novel conservation concept we told you about in our February '77 issue called Annual Cycle Energy System (ACES) is proving highly successful. During early January's peak cold, a demonstration house using ACES for space heating and hot water required

about one-third the electric power of a similar house with conventional electric-resistance heating. During cold weather, ACES uses a heat pump to extract heat from water in a large insulated tank. The water freezes into a giant ice cube yielding 144 Btu for every pound of water frozen. If this seems puzzling to you, I suggest you go back and re-read our February story for a complete explanation. The experimental houses providing these data are located near Knoxville, Tenn. During the week of January 9, the ACES house used only 36 percent of the electricity needed by the nearby control house. The peak demand with ACES was four kilowatts, compared with 14 kilowatts for the control house. This 71-percent reduction in peak load occurred at 8 a.m. on the coldest mornings—at the same time that demand on the local power system was near its maximum. The promise of ACES is not only the reduction in total energy consumed, but substantial shaving of peak demand load, which is costly for power companies to supply.

Flying-scissors concept revived

A startling idea for an SST jetliner was the PS cover story in October '72. According to NASA research on which the cover painting and accompanying story were based, the wing would pivot during flight much like the blades of a pair of scissors. The design would provide a plane that would take off and land at moderate speeds with the wing normal, and fly at supersonic speed (Mach 1.2) with the wing skewed. It would use less fuel than present SST's and produce no sonic boom audible on the ground. The designer, Dr. R. T. Jones, told PS Flying Editor Ben Kocivar that a full-size prototype could be flying in five years. No further news on the project surfaced until recently: We just got word that a contract has been awarded to Ames Industrial Corp., Bohemia, N.Y., for the development and fabrication of a small manned oblique-wing aircraft. Because the pivoting oblique-wing concept is a significant departure from conventional aircraft design, NASA says it is proceeding with this low-cost exploratory program to study

the fundamental aspects of piloting an oblique-wing aircraft. Called the AD-1, the aircraft will be about 40 feet long with a wingspan of 32 feet. It will be powered by two 400-pound-thrust turbo-jet engines. The first flights are planned for early 1979.

Underground coal gasification

Extracting energy from underground coal without having to dig up the coal is a possibility that has attracted researchers all over the world for many years. The idea is to burn the coal where it lies and recover the resulting gases. The Department of Energy is funding a number of projects to explore the technology. A report on the project at Hanna, Wyo., is very encouraging. Using air injection, Hanna II project produced the highest heating-value gas over the longest duration ever reported; operated at the highest thermal efficiency ever reported; gave the highest production rate from any test in the Free World.

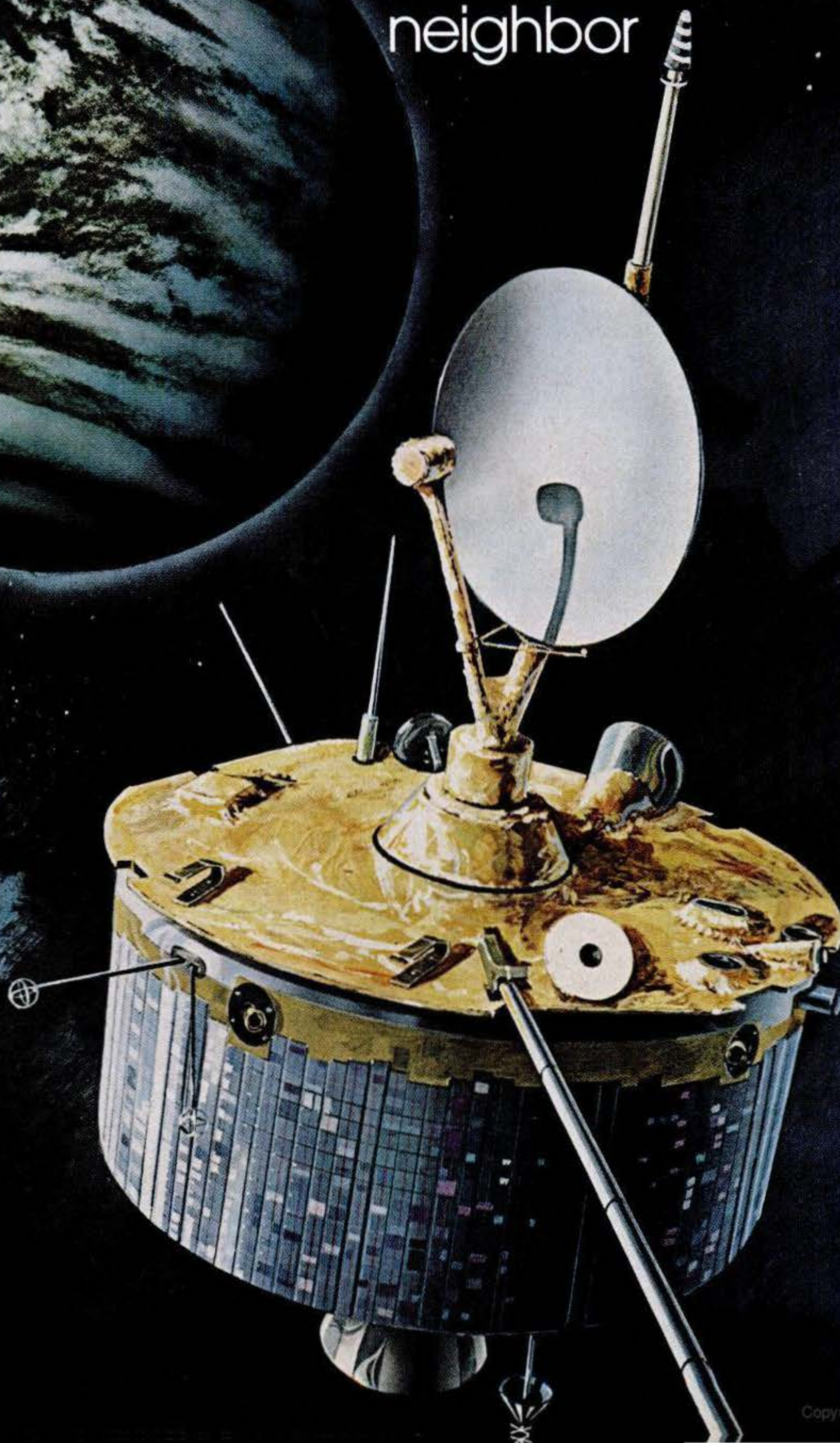
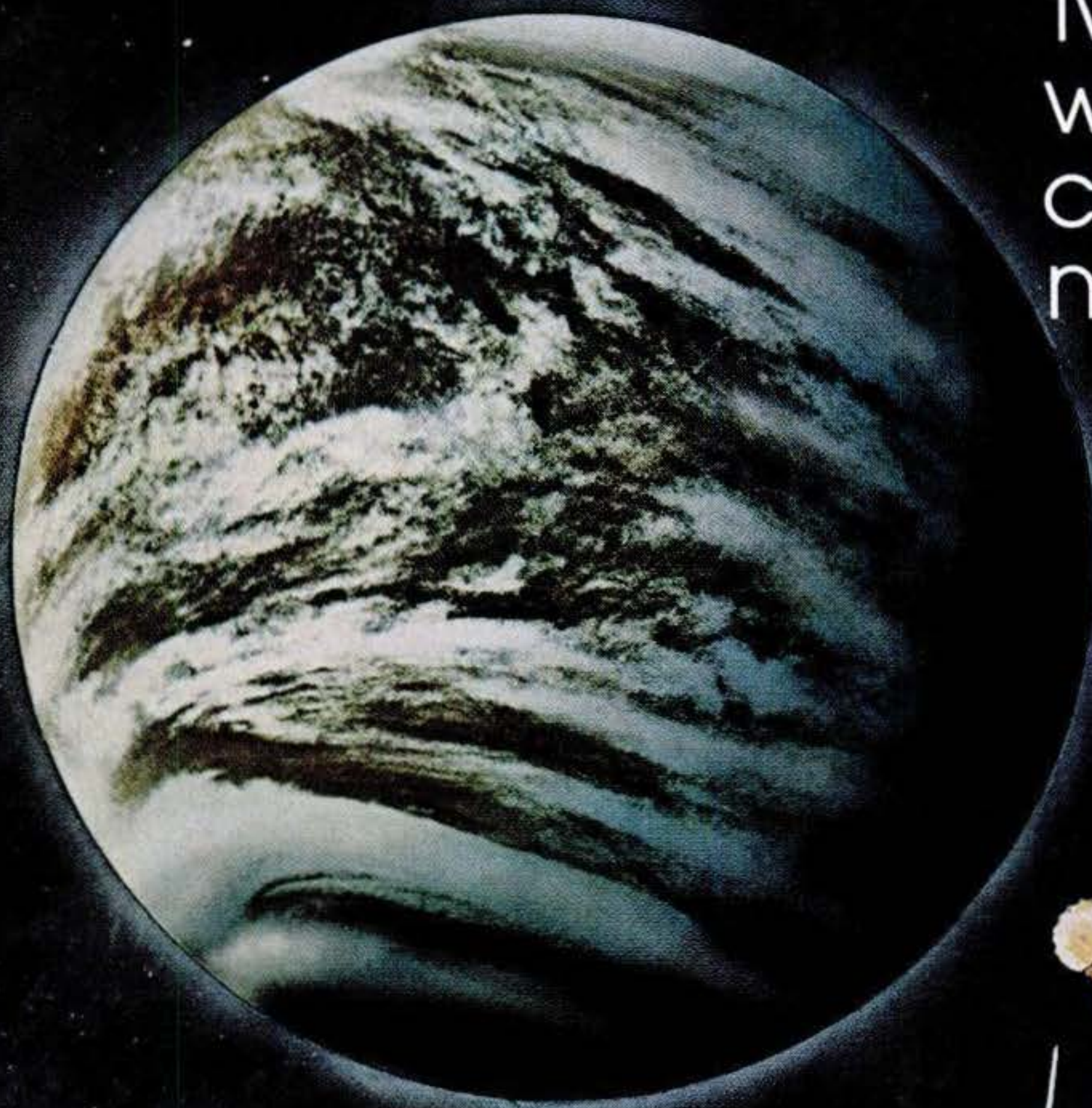
A reminder about backflow

A sneaky hazard that everyone with indoor plumbing faces every day is the inadvertent cross-connection—an accidental hookup—between your pure-water supply and contaminated waste water. Common practices found in almost every household can set the stage for deadly backflow to occur. A connected garden hose with the open end submerged in a puddle of water on your lawn is one such. A recent report to the U.S. National Committee on Vital and Health Statistics recalls an article in PS, December '74, which detailed the mechanisms by which backflow can occur and how to prevent it. The report warns that diseases related to drinking water—controlled and reduced for 20 years—are no longer declining in the U.S. Outbreaks of such diseases in the four years 1971-74 were nearly double the number of outbreaks for the years 1966-70.

Hubert P. Luckett
Editor-in-Chief

Pioneer Venus

Two spacecraft
will study Earth's
cloud-shrouded
neighbor



Orbiter spacecraft, glistening with solar cells and insulating covers, will map the Venusian atmosphere and planetary surface by remote sensing. An elliptical orbit will enable the spacecraft to pass through the planet's upper atmosphere, making direct measurements of interactions between the solar wind—charged particles—and the ionosphere.

Instrument-laden probes will penetrate the atmosphere as an orbiter scans from above

By JIM SCHEFTER

Imagine a planet where the clouds are sulfuric acid, where the upper atmosphere blows along at more than 200 miles per hour, and where the sun rises and sets twice a day.

Now design a spacecraft to go from here to there, then send five probes plummeting through those clouds, reporting back on what they find. Design a second ship to orbit the planet, dipping into that corrosive atmosphere at a low point in its path.

Finally, contend with the fact that there is no way on Earth—literally—to test those craft against conditions they'll encounter at their destination.

The planet is Venus. The spacecraft are Pioneers. The people with that improbable assignment are at NASA's Ames Research Center in Mountain View, Calif., and at Hughes Aircraft Company just south of the runways at Los Angeles International Airport.

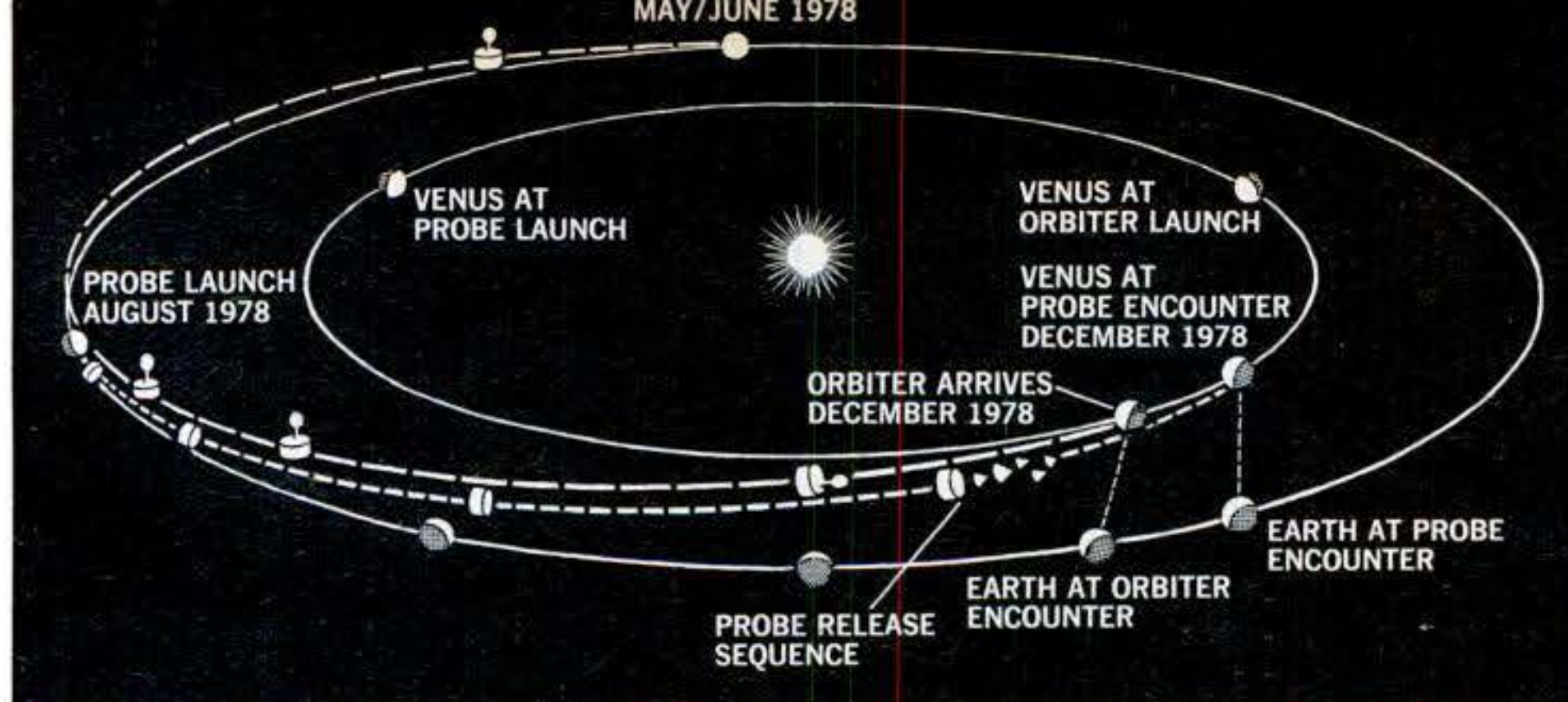
"Pioneer Venus is two missions in one," Dr. Larry Colin says. "There's a launch in May and a launch in August, with both spacecraft reaching Venus in December."

Colin is project scientist at Ames. He recites mission details without glancing at nearby charts or documents. Pioneer 12 is the orbiter, to be launched about May 21. It should reach Venus on December 4, five days ahead of the multiprobe Pioneer 13 to be launched about August 7.

Romanticized as the morning or evening star, Venus is brightly visible from Earth. But by any standards, it is a terrifying and gruesome place up close. "We think the atmosphere is one gigantic machine," Colin speculates. "We hope to find the driving force that makes the upper atmosphere move faster than the planet's surface."

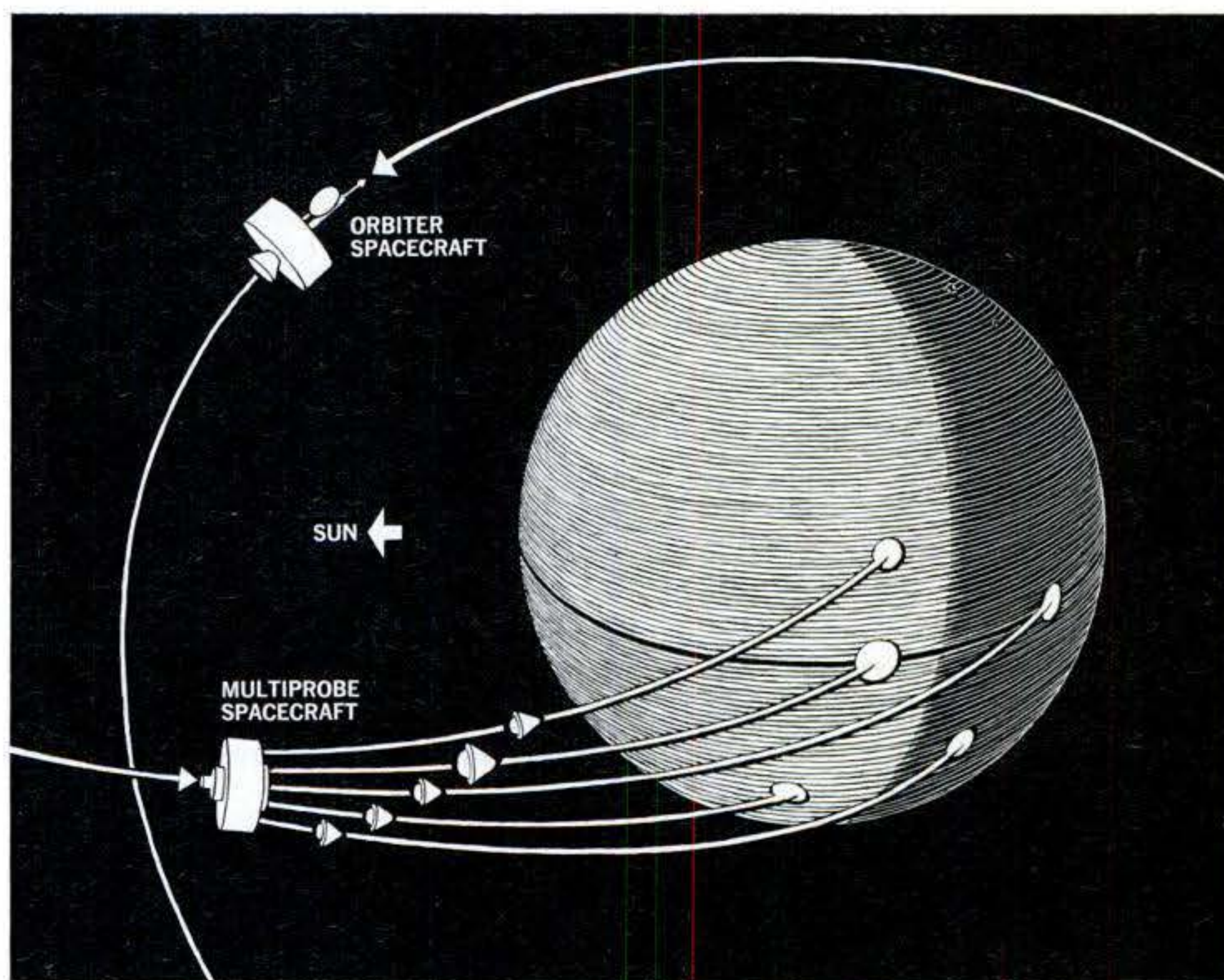
Indeed, the Venusian surface barely creeps along. Venus spins on its axis—in a backward or retrograde direction—just once every 243 Earth days. Thus a rotational day on Venus is 243 days on Earth, longer than a Venusian year of 225 Earth days, resulting in two sunrises and sunsets every rotational day. (More pointedly, a solar day on Venus, the time from sunrise to sunrise, is 116.8 Earth days.)

Meanwhile, the upper atmo-



Close encounters of Earth and Venus in their orbits will occur as the orbiter and multiprobe spacecraft reach Venus after

staggered launchings. Orbiter spacecraft will be circling Venus when multiprobe mission arrives (see below).



Atmospheric probes penetrating the thick Venusian cloud layer will radio temperature, pressure, and rotational data back to Earth. Largest of the probes launched from an eight-foot-diameter

"bus" will be parachuted into an equatorial region. Smaller probes and the bus itself will penetrate other regions. Orbiter's elliptical orbit will brush the planet's atmosphere.

sphere is turbulently active, moving at a speed of about 223 miles per hour, Colin said. At that rate, it circles the slow-moving surface every 100 hours or so.

Much of what is known about Venus today derives from 13 spacecraft—10 Russian Veneras, three U.S. Mariners—that have visited the planet, and from Earth-based radar and radio-astronomy measurements. All three U.S. craft were flybys, limiting their data output. Five Veneras landed on Venus, but the longest survival time was just 107 minutes. Several Veneras were combination orbiter and lander, and at least two landers transmitted photos of a dry, rocky terrain that appears volcanic.

But all that is just the beginning of what the newest Pioneers will

find at Venus. The upper cloud layer may top out at 50 miles above the surface, and, as Colin says, those clouds are now believed to be sulfuric acid and water. The cloud deck may be 19 or 20 miles thick.

The last 30 or so miles to the surface is an enigma. It may be clear air—actually 95 to 97 percent carbon dioxide. But Colin points out that Russian data indicate some scattered cloud layers in that lower atmosphere, though nobody, including the Russians, knows for sure.

With low clouds or without, the temperature and atmospheric pressure go up until, at the planet's surface, it's like standing in a 920° F oven under 3000 feet of water.

Colin cites three atmosphere-

Continued

related goals for Pioneer Venus: explain the high pressure, explain the high temperature, and explain the cloud/surface rotational differential. "If we can explain the high temperature, we'll also have the answer to the pressure," he predicts, "and the pressure probably drives the circulation while the circulation moves the pressure around."

"We hope to tie all three into one theory. If we can do that, the theory ought to apply to some meteorology on Earth."

But first, Pioneer's probes must do their job. That won't be easy, says Steve Dorfman, Hughes Aircraft project manager.

"We've encountered a series of technical problems, particularly in verifying that the spacecraft perform as designed," Dorfman admits. "But the biggest problem of all was to design the probes to withstand the Venusian atmosphere," he said.

The Pioneer multiprobe spacecraft is a spin-stabilized bus about eight feet in diameter and weighing more than 1760 pounds. Solar cells gird its exterior. Four spherical probes—three small, one large, and each nestled inside bluntly rounded, bulletlike heat shields—squat atop the bus. The fifth probe is the bus itself; it should be ripped apart and incinerated long before it can reach the Venusian surface.

It is the other four that keep Steve Dorfman on his toes. The three small probes are identical, each containing instruments for three experiments. The large probe carries seven. But before any of them can be actuated, the probes must survive incredible tortures.

For most of their journey, the probes are quiescent passengers. Then about 24 days out from Venus, the bus will be aimed like a fat cannon and the large probe released on a trajectory that will bring it to equatorial Venus on the daylight side of the terminator.

One-way probe

From the moment of release, the probe is on its own. A clock starts, and every event thereafter is just a matter of timing. Even its radio signals are one-way only. The probe transmits. Earth listens.

The large probe is a five-foot ball weighing about 642 pounds. It carries 62 pounds of scientific instruments. Most important of them, according to project scientist Colin, is a neutral-particle mass spectrometer. Its objective is to determine the composition of the lower Venu-

sian atmosphere, the region least understood for now.

Analyzing the spectral properties of the ever-thickening atmosphere as the probe sinks toward the land surface, the spectrometer is designed to provide data on amounts and vertical distribution of noncorrosive gases, on cloud layers encountered, on chemically active constituents of the atmosphere, and more.

"If that instrument alone works," Colin says, "the mission will be a success."

Other devices aboard the large probe are:

- A gas chromatograph that will not only give added data on lower-atmosphere composition, but may pinpoint the reason why infrared radiation doesn't penetrate it. The result could be better knowledge about why the Venusian surface is so hot.

- A cloud-particle spectrometer to measure size and density of

“It has been very difficult to test this spacecraft . . . We just can't duplicate Venus on Earth”

cloud components. The instrument begins to work about 45 miles above the surface by bouncing laser light off a small deployed mirror, then recording interference patterns in the reflection.

- A solar radiometer that will measure solar energy continuously through the atmospheric fall.

- An infrared radiometer that will spot heat sources and heat sinks, detect cloud layers, estimate the water content in the lower atmosphere, and more.

- Atmosphere-structure instruments, a package that will operate from an altitude of about 40 miles to the surface to give temperature and pressure profiles, atmospheric-density data, and information on winds and turbulence.

- A nephelometer that will monitor light variations to determine both the presence of clouds and their layering.

The latter two experiments are duplicated in the small probes. Four days after the large probes depart—now 20 days to planetfall—the spinning multiprobe bus is aimed again at Venus and the three small probes released. They should bracket the planet's face. Two are targeted to descend in the dark, one

near the eastern equator, one near the north polar region. The third should impact the far southern hemisphere in daylight.

Each small probe is a 28-inch ball weighing about 189 pounds and carrying 16 pounds of instruments. Each is nested inside its blunt-bullet heat shield. The only experiment unique to the small probe is a net-flux radiometer that should provide data on energy radiating within the atmosphere or from the surface, and then relate those data to atmospheric motion, temperature, and clouds.

Modeling the atmosphere

"The three small probes complement the large probe by taking measurements at scattered points around the globe," Colin explains. "Because we know there is no temperature differential from day-side to nightside, we can hope to model the atmosphere with just four probes. It's something we couldn't do on Earth or Mars."

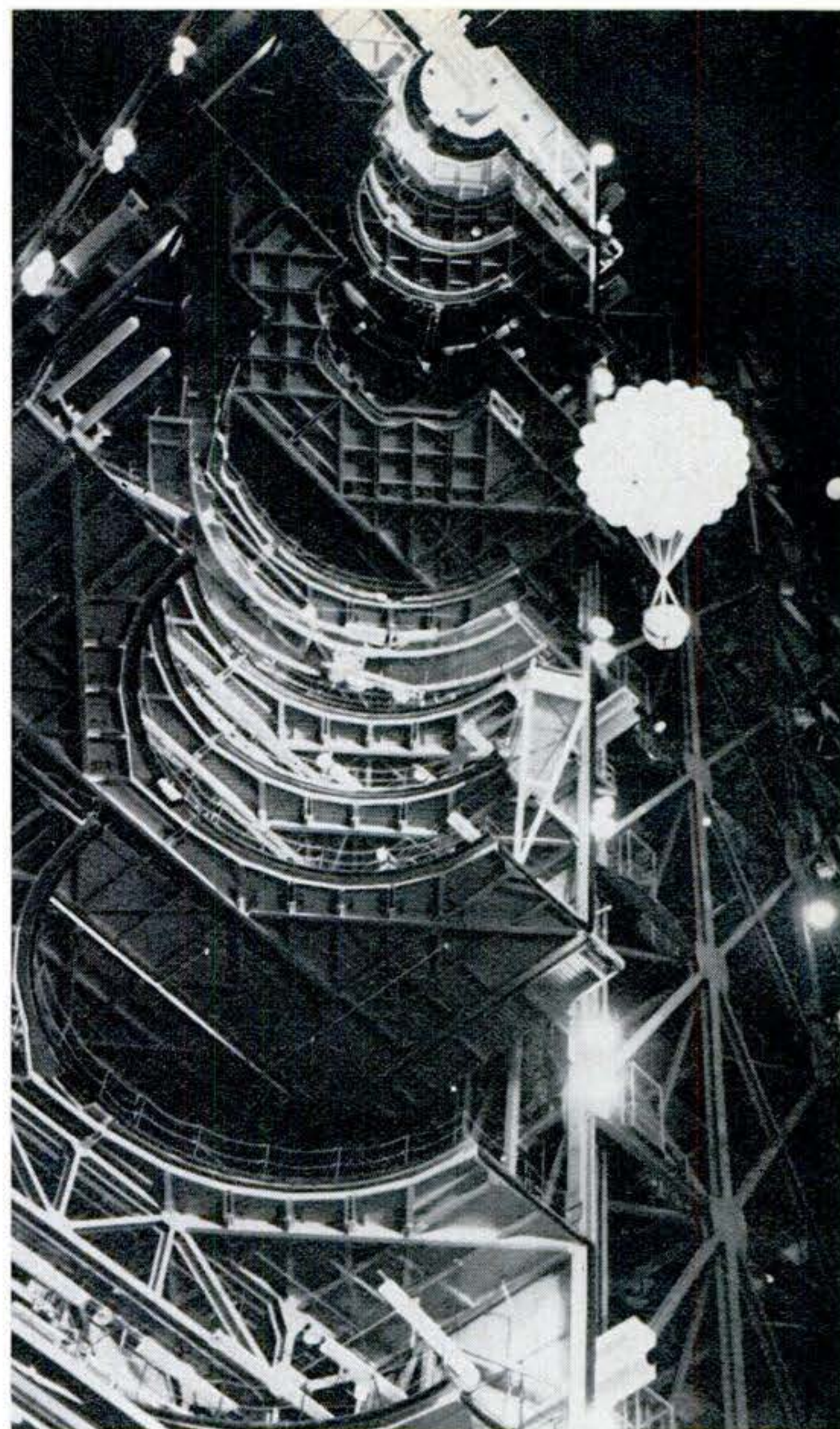
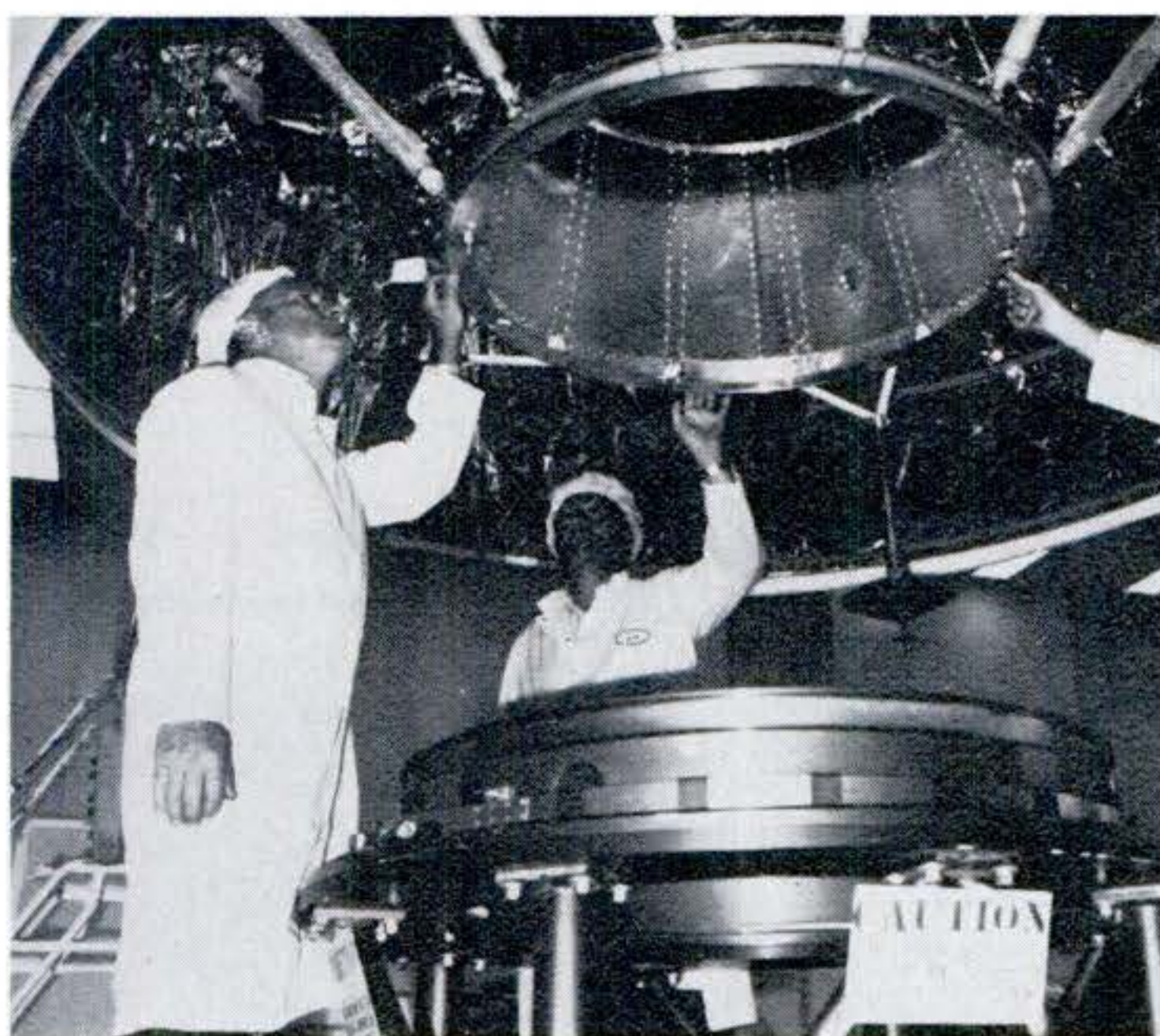
With its passengers gone, the bus will be slowed slightly to time its arrival for about 90 minutes after all probes have reached the surface. It carries two scientific devices, an upper-atmosphere mass spectrometer and an ion-mass spectrometer, to perform *on-site* measurements of high-altitude gases and charged particles. It should report data from about 1200 miles to about 85 miles out before tearing apart and vaporizing in the intense entry heating.

But targeting accuracy must be within one-half degree to make that happen, Charlie Hall cautions, and the bus could skip back out into space instead. Nobody will know until it happens one way or the other during the mission.

It's the thought of plunging through the Venusian atmosphere that gives Hall and Dorfman nervous days. Forget the high-altitude winds and sulfuric-acid clouds. Look at what happens next in the descent.

For 24 days, the large probe coasts silently toward Venus. Only that small timer, set just before leaving the bus, draws power. In the last few hours, the probe's speed increases rapidly. When it hits the outermost reaches of Venusian atmosphere, it will be plunging planetward at 38,000 feet per second (about 25,900 miles per hour).

And 2½ hours before that, the timer should click on the first of the probe's radios. At 22 minutes from entry, all subsystems come



Floating earthward from atop the Kennedy Space Center's assembly building, a parachute system designed to carry an instrument-laden probe through the dense atmosphere of Venus is tested. Technicians check the multiprobe spacecraft and the orbiter vehicle (left, above). Parabolic antenna on orbiter will be aimed at Earth throughout its mission. At left is a test model of the "bus" that will carry four detachable probes to Venus.

on. At this point, signals should be heard by the Deep Space Network stations on Earth. Five minutes later, all science instruments activate in the probe.

Any malfunction at this point is long beyond help. With everything connected to that timer, and no way for controllers at the Ames center to relay correcting commands, the probe is on its own.

Slamming into the atmosphere, it will decelerate at forces up to 323 g. Its aeroshell heat shield should protect it from temperatures in the thousands of degrees, but only good design will save it from such high g forces. As the atmosphere thickens and the descent rate slows, the g force drops off sharply. A brief blackout period ends and at

about 39 miles altitude, the probe's 16-foot parachute deploys.

At the moment of deployment, almost certainly inside the high Venusian cloud layer, the spherical probe pulls free from its heat shield. Now only the pressure vessel and its chute remain. During the next long minutes, the large probe will be chattering data back toward Earth at high speed. Every instrument should be feeding new information to scientists waiting at Ames and elsewhere.

The probe itself will be undergoing yet another series of tortures. Unprotected by its heat shield, it will be encountering severe and increasing outside temperature and pressure. As it wobbles deeper and deeper into the Venusian atmo-

sphere, like a marble dropped into the ocean, the probe will encounter outside temperatures reaching 920° F or more. Yet the delicate electronics inside must be kept cooler than 120° F.

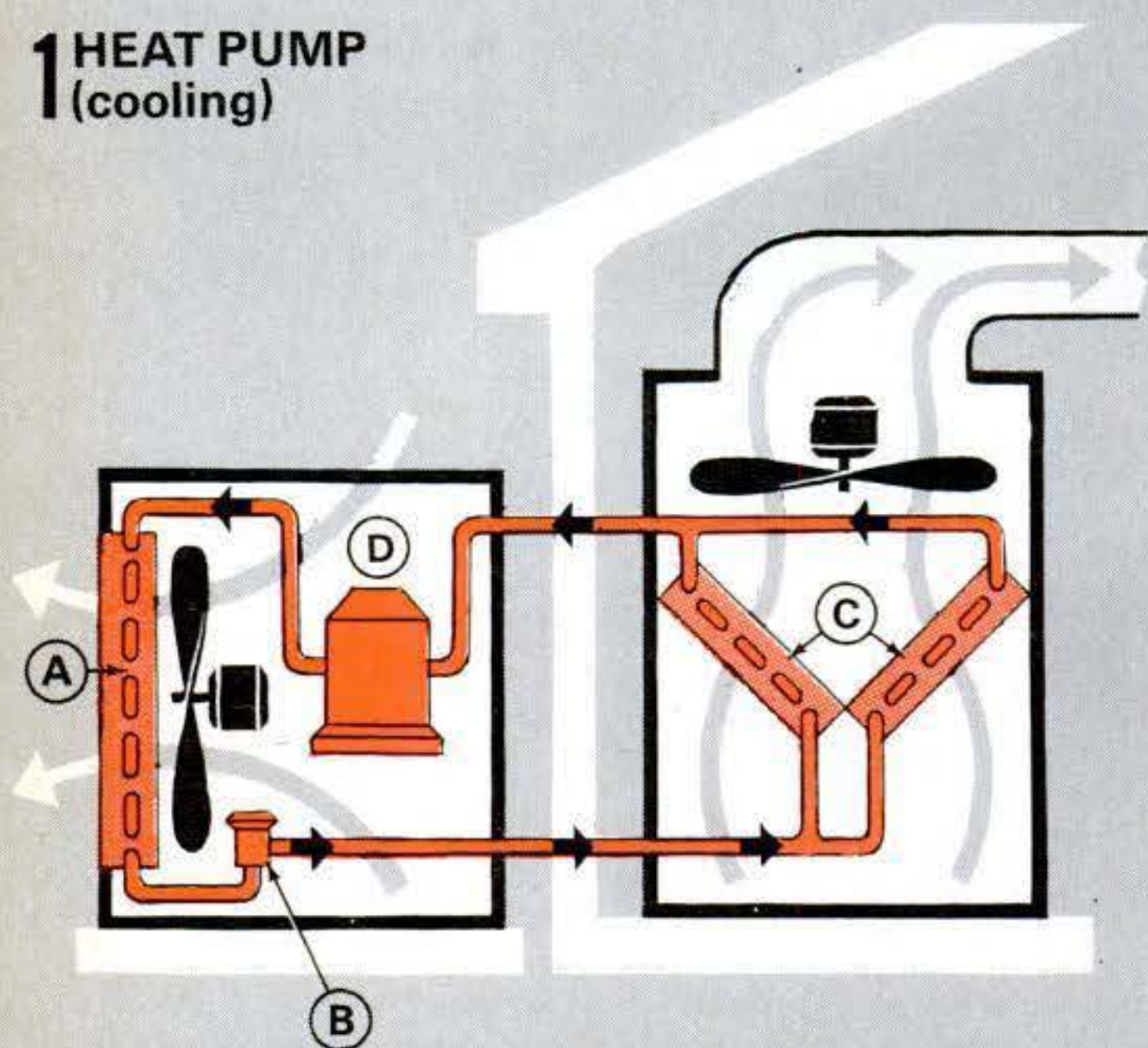
Heat shields

First Hughes developed an insulation—"our first line of defense against the heat," Dorfman calls it—of more than 50 layers of Kapton. The inch-thick insulation pad lines the inner shell. Then beryllium shelves were designed both to hold electronic components and act as heat sinks. Finally the probes were filled with nitrogen because it transmits heat less easily than most gases.

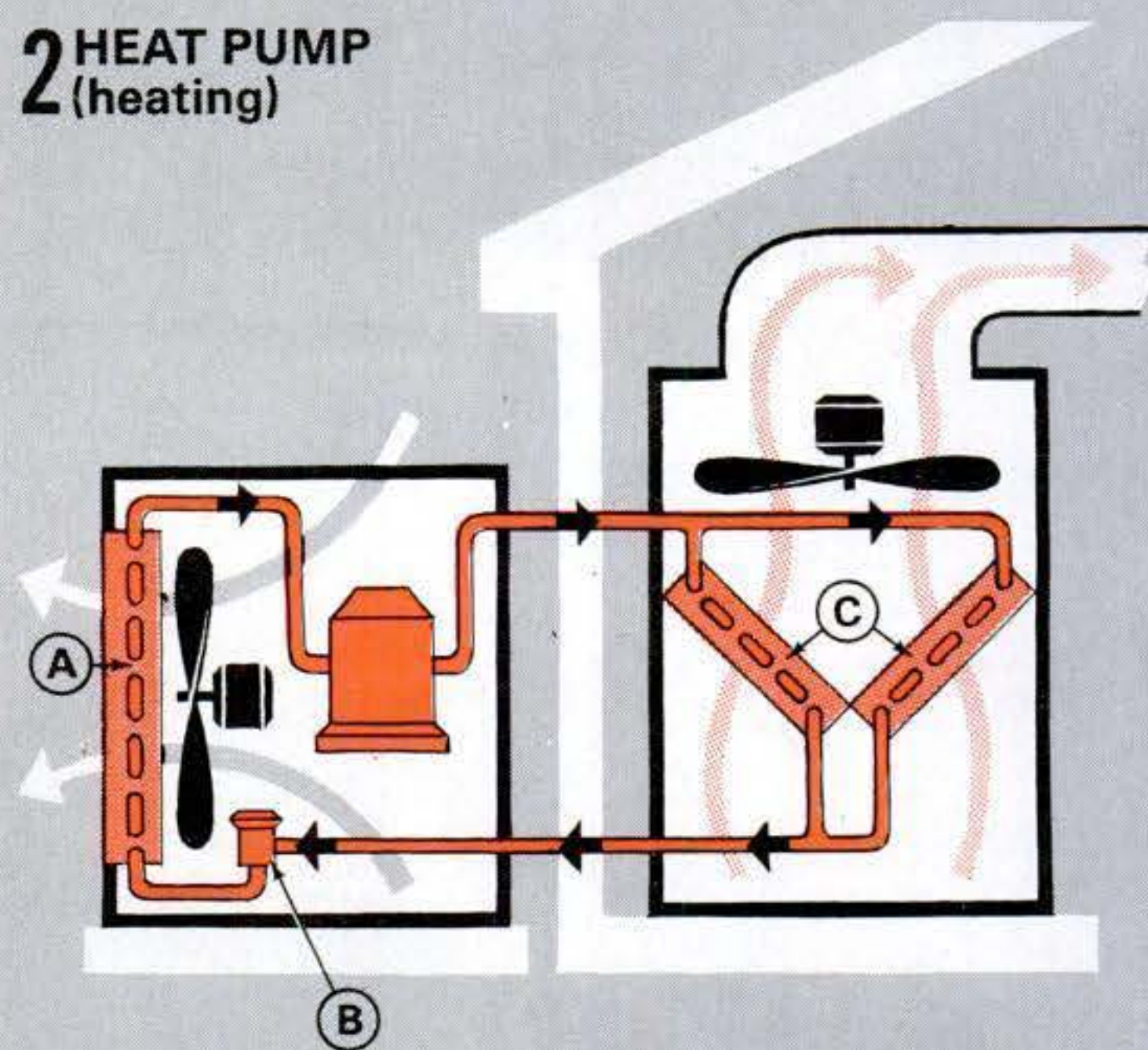
[Continued on page 169]

Higher efficiency with **solar-assisted heat pumps**

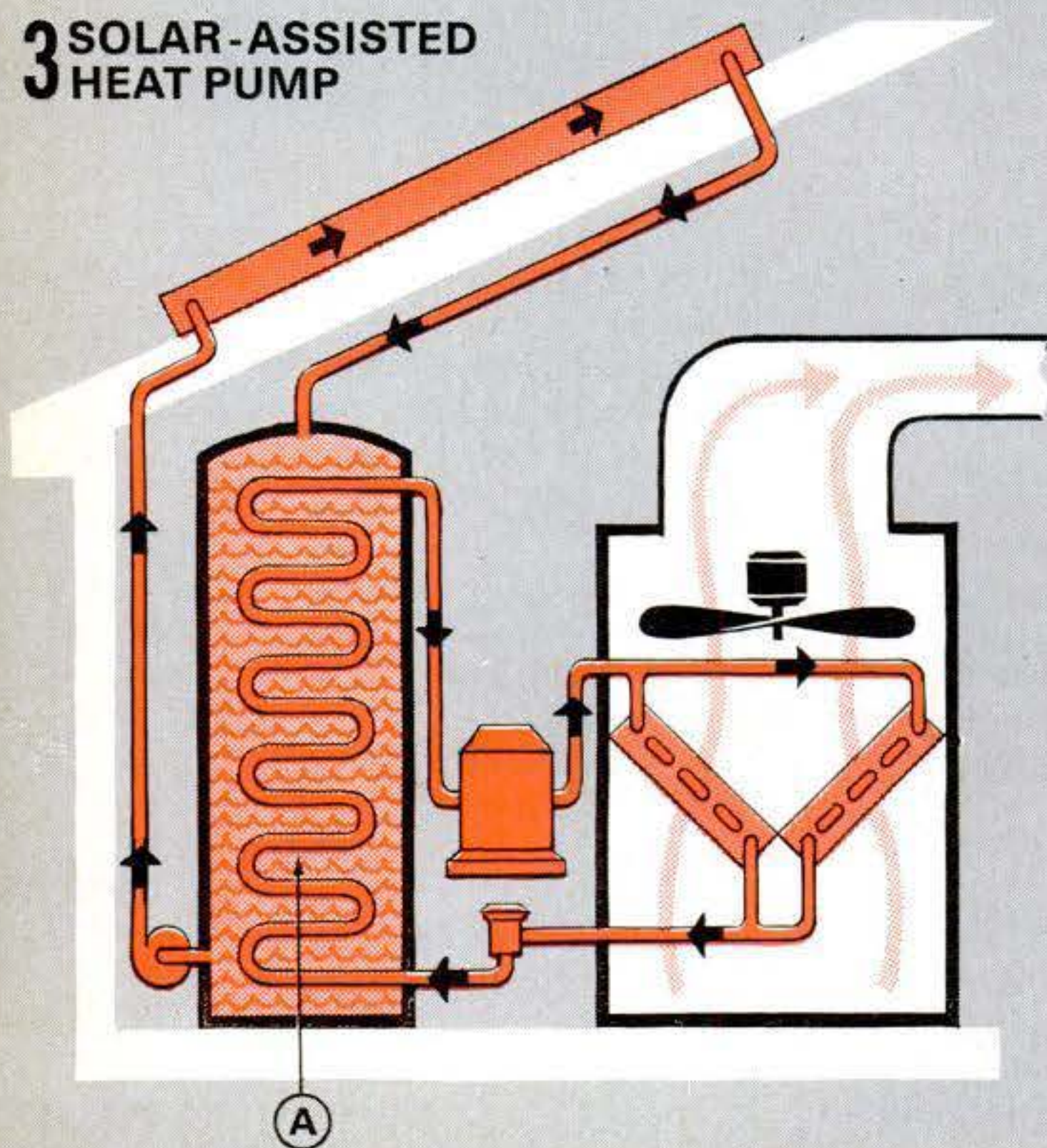
1 HEAT PUMP
(cooling)



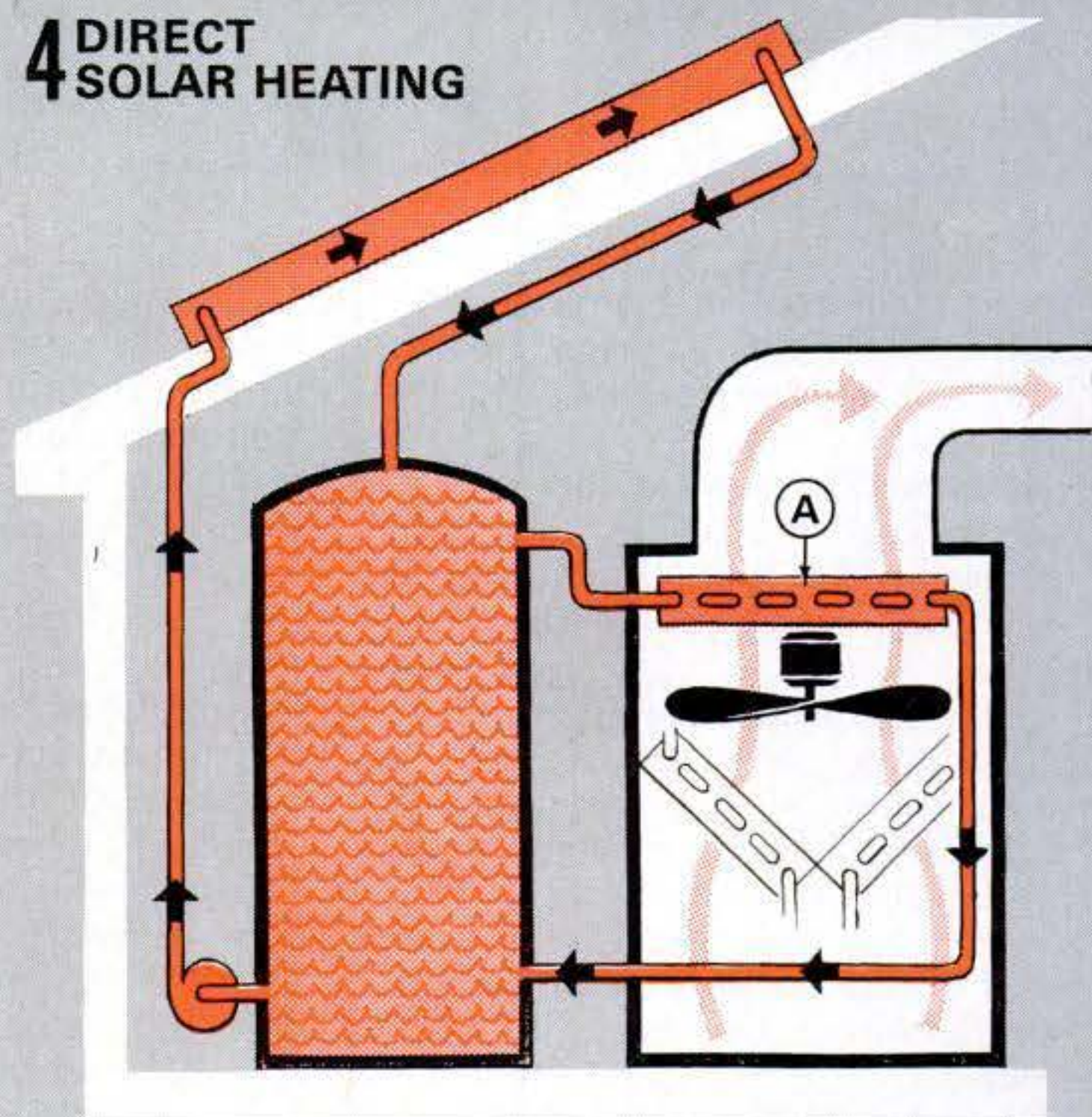
2 HEAT PUMP
(heating)

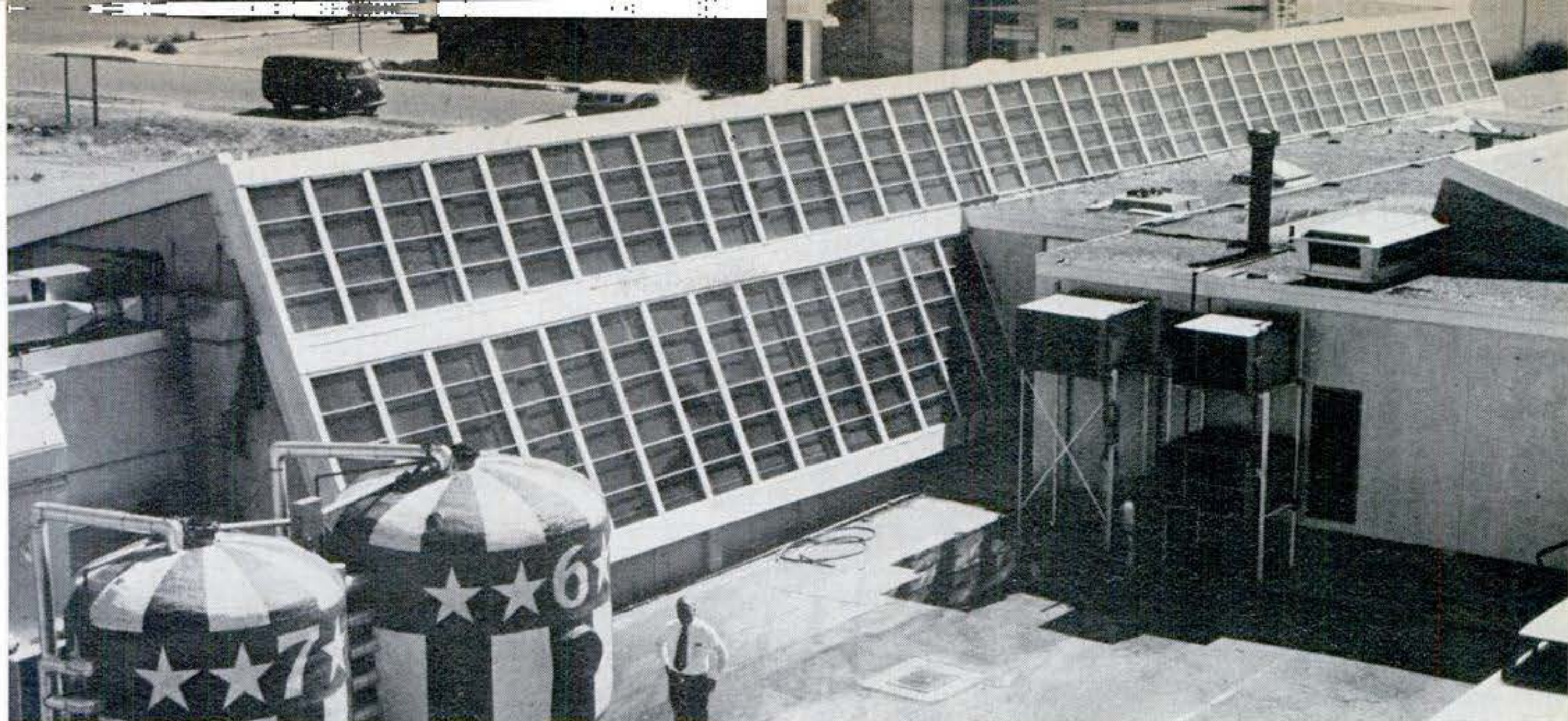


3 SOLAR-ASSISTED
HEAT PUMP



4 DIRECT
SOLAR HEATING





World's first solar-assisted heat-pump system was installed in headquarters of Albuquerque engineering firm in 1956.

Link these two systems, engineers say, and they compensate for each other's limitations

By C. P. GILMORE

Solar heating is a great idea. Under the right conditions it uses little or no irreplaceable fuel. But its high initial cost usually makes it an expensive way to go. And sometimes the sun doesn't shine—or doesn't shine enough.

The heat pump is a great idea. It furnishes heat in the winter, cooling in the summer. But it does use some energy, although not as much as electrical resistance heating. And its efficiency as a heat source falls off badly just when it's needed most—when the weather gets really cold.

Now, many heating and cooling engineers are suddenly interested in what has been called a marriage made in heaven—the wedding of the heat pump and the solar collector. While the cost of a combination system is high—the setup re-

quires two systems instead of one—the overall improvement in system efficiency may allow the use of fewer or cheaper solar collectors than would be used in an all-solar installation.

To get a better understanding of both the benefits and problems involved in this technique, I recently made a swing around the country, visited the projects, and talked to the engineers who designed them. My conclusion: The solar-assisted heat pump is not only an elegant idea. In some cases it may turn out to be an important way to get the heating and cooling we need and at the same time save substantial amounts of fuel. But there are problems. And not all engineers are convinced it's the way to go. Here's why.

The physics of compatibility

To see how heat pumps and solar systems can work to improve each other's efficiency in one typical configuration, take a look at the operating characteristics of each.

A solar collector absorbs the sun's rays, turns them into heat,

then keeps the heat from escaping long enough so that it can be transported by a working fluid—water or air—into the house where it can be put to work. Just how well it does this depends largely on the temperature difference between the collector plate and the outside air. As the graph on page 88 shows, collector efficiency falls as the temperature difference increases. When the difference is 10 degrees, the collector operates at 80-percent efficiency; it captures 80 of every 100 Btu that fall on it. But when the difference rises to 90 degrees, efficiency plummets to less than 40 percent.

The heat pump suffers from similar problems, but for different reasons. A heat pump makes heat flow "uphill" from a colder to a warmer place instead of the other way around as it would do naturally (see diagrams). Thus it can pump heat out of your house in summer, while in winter it extracts heat from outside air and pumps it into the house. (Outside air always contains some heat, even when it seems frigid to human senses.) A

Continued

During cooling cycle (1), heat pump works like standard air conditioner. Refrigerant flows from the condenser coil (A) through the expansion valve (B) and on to the evaporator coil (C). There the low-pressure liquid boils, extracting heat from air flowing over the coils. Cooled air is distributed through house by air-handling system, while refrigerant goes through compressor (D) and then on to outside condenser coil. There it gives up heat collected inside, and at the same time changes back into a liquid, ready to start cycle again. In heating cycle (2), operation is identical in principle, but reversed in sequence. In this so-called reverse-cycle heating mode, inside coil (C) is now condenser. Refrigerant flows from condenser through expansion valve (B) and on to evaporator coil (A), which is now the outside coil. There, because of its extremely low boiling point, refrigerant boils and extracts heat from outside air. Leaving outside coil, the vapor flows through com-

pressor, then on to condenser in the air-handling system where it gives up heat it has collected, condensing back into a liquid in the process and then flowing to expansion valve to repeat cycle. In solar-assisted mode (3), both solar panels and heat pump work at more effective points on their operating curves (see text). In this system, solar panels collect heat and store it in tank. Evaporator coil, outside in conventional system, is now in warm tank, from which it can extract heat with far greater efficiency. Principle of cycle and flow of refrigerant is the same as in conventional reverse-cycle heating (2). When temperature of water stored is high enough—say above 100° or 110° F—system switches to direct solar heating (4). Hot water flows directly to heat exchanger in plenum (A), heating air. Operating costs are lowest in this mode, since only fan and small pump are consuming energy. When tank temperature drops below 100°, system reverts to heat-pump mode.

A heat pump's efficiency falls off badly just when it's needed most

simple valve arrangement lets the heat pump operate in either direction.

The colder it gets outside, however, the harder it is for the heat pump to extract heat from the air. Engineers measure heat-pump efficiency by a number called the COP—coefficient of performance. The COP tells how many Btu of heat energy are delivered inside the room for every Btu of electrical energy used to run the heat pump.

You might think a heat pump is defying the laws of conservation of energy. With a COP of, for example, 3 (a typical number under actual operating conditions) it delivers three units of heat energy for every one of electricity you put in. The trick is that the unit is simply moving the heat—from outside to inside—not converting it from chemical energy as burning oil or gas does.

COP falls with outside temperature, while the building's need for heat increases. At a temperature often in the 30's, the way most systems are designed, you reach the balance point—when the house requires more heat than the installed heat pump can deliver. At that point, most systems using heat pumps switch to resistive electrical heating, either to supplement the heat-pump output or to substitute for it.

Thus both solar heat and heat pumps, despite their attractiveness, have limitations. But when you put the two systems together, they can go a long way toward compensating for each other's problems.

Envision a combined system. The sun is shining and the outside

temperature is 20° F—below the heat pump's balance point. The solar collectors are operating at 60° F, where they are 65 percent efficient (their efficiency would drop to 45 percent or less if they had to operate at the 100° or higher temperature needed for direct solar heating). With its evaporator coil in the 60° water, the heat pump is also operating at very high efficiency—far higher than it would in the 20° air outside. So both units are operating at nearly ideal levels.

You may have noticed one fact that I skipped over in my preceding description. In one case, the evaporator coil of the heat pump was absorbing heat from the outside air and releasing it into the air inside the house (air-to-air). The second example is a water-to-air heat pump; the evaporator coil is extracting heat from a tank of water heated by the solar collectors. The principle is the same in both cases; only the engineering varies to allow the evaporator and condenser coils to work properly in whatever substance they're designed for.

So far I've described only the winter heating cycle. In the summer, several modes of operation are possible. In cooling mode, of course, the heat pump is extracting heat from the air in the house and rejecting it to the tank of water. The easiest and most common way of getting the heat out of the house altogether is to run the water through an outdoor cooling coil, where it cools by convection. You might get even better efficiency by letting the temperature in the tank

rise during the day and then using the cooling coil at night when it is more efficient. In another variation, collectors use air as a working fluid, store heat in a bin of rocks, and use an air-to-air heat pump. In this case, heat could be rejected with proper ducting to the outside air for summer cooling.

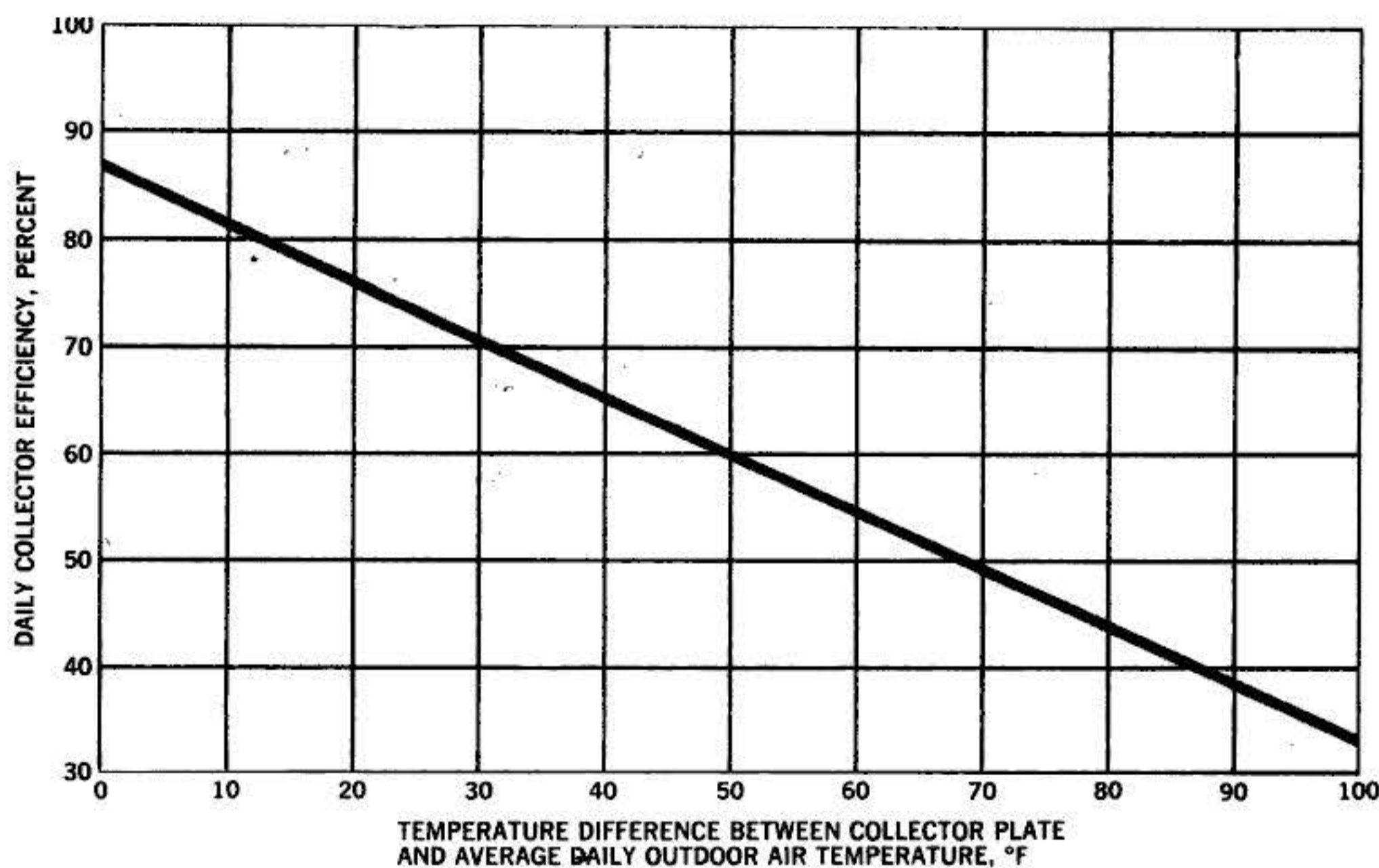
A discovery in Albuquerque

The idea for the first commercial solar-assisted heat pump was hatched back in 1954, when the firm of Bridgers and Paxton got a contract to engineer the heating and air-conditioning systems for a building in Albuquerque, N.M., that has glass walls facing north and south.

"The south side of these glass-walled buildings normally has to be cooled on sunny days, even in winter," Frank Bridgers told me recently in his Albuquerque office. "So it was general practice to buy gas to heat the north side and refrigeration to cool the south side. We designed a heat-pump system for this building, and drilled two wells, one as a heat source for the heat-pump system, the other for reinjection of the water [PS, Feb.]. But we discovered that on cold, sunny days, we were not using the well water. Enough heat was coming in the south side to provide a heat source for the heat pump used to heat the north side. We used the well water only at night or on cloudy days. So we decided then that if you could accidentally solar-heat a building, even when the architect provided drapes and heat-absorbing glass, think what you could do if you did it on purpose."

So Bridgers went on to use the same principle in the design of a small headquarters building for his firm. It was built in 1956, and was the country's first solar-assisted heat-pump installation in which solar collectors were used to increase the efficiency of the heat pump (see photo). The building was a smashing success. Even though Albuquerque had the cloudiest January in weather history that first year the heat-pump system used only eight percent of the energy that would have been required for a conventional system.

The building's flexible control system allows it to operate in several modes. "When the solar-heated water in the storage tank is hot enough," says Bridgers, "we just run it right through a coil in the air-handling unit and heat directly

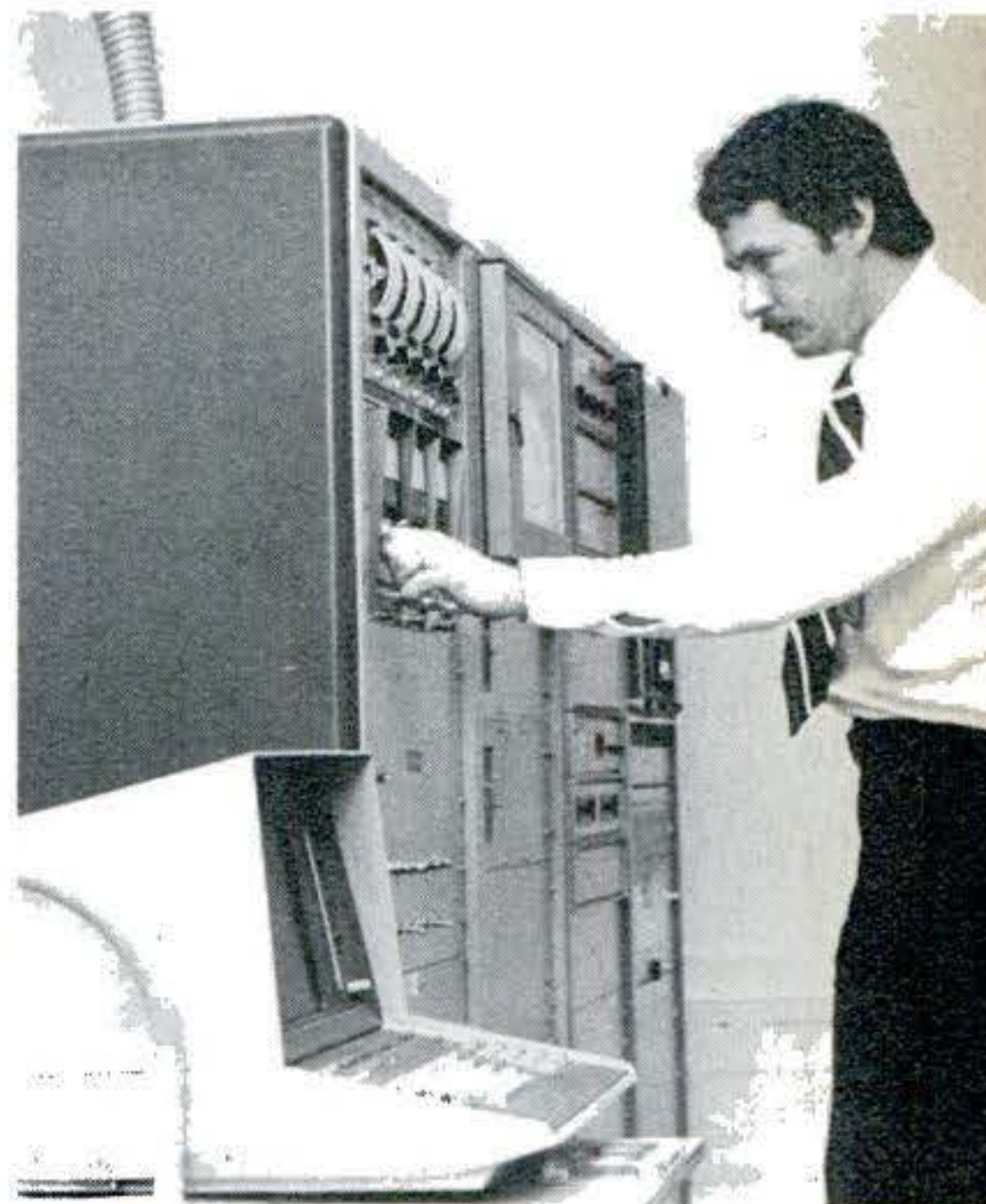
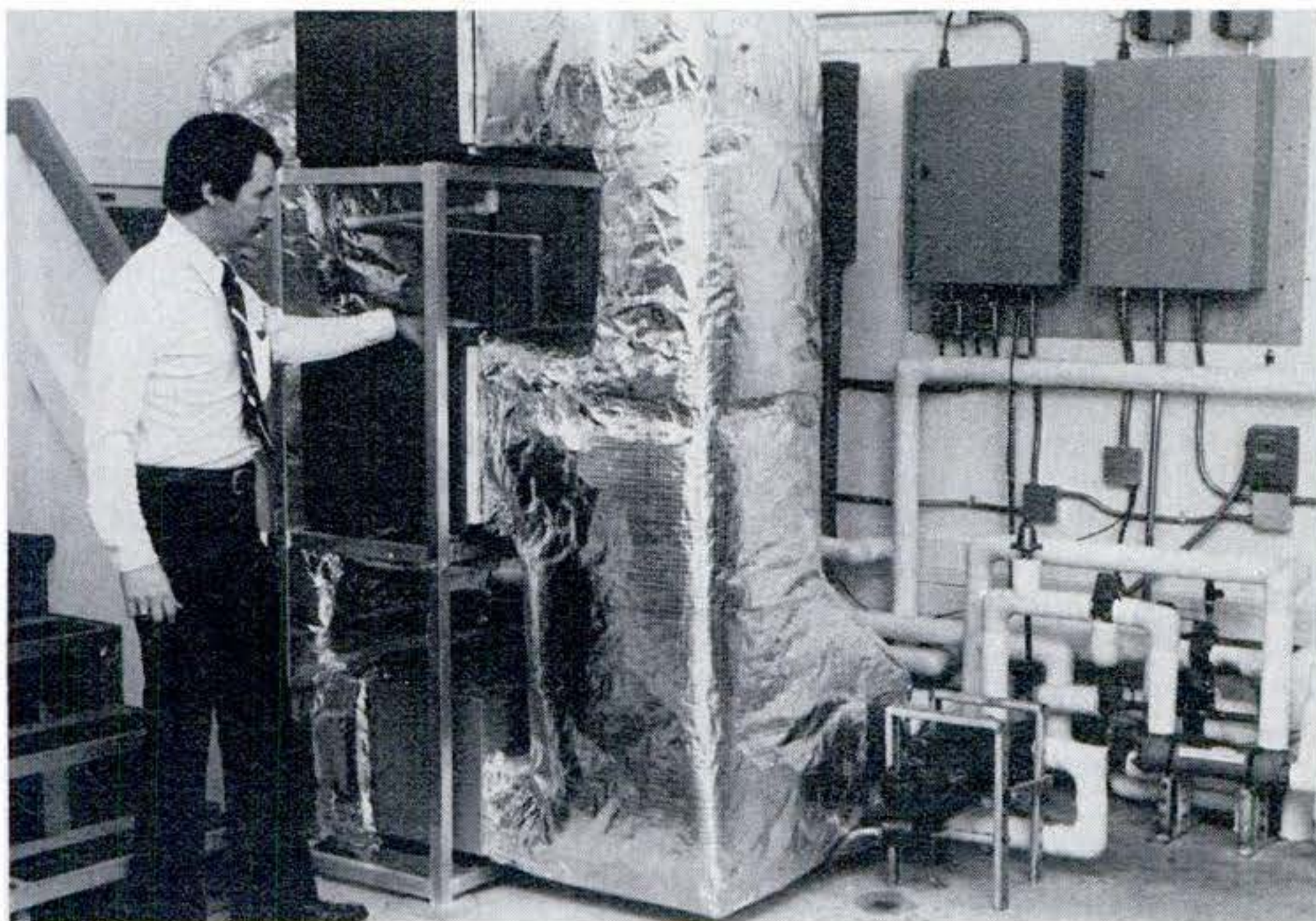


Efficiency of solar collector drops rapidly as temperature difference between

outside air and collector plate increases. Slope changes with collector design.



NASA Tech House at Langley Research Center, Va., has solar-assisted heat-pump system, energy-saving insulation, and a computer (below) to monitor and control all building operations. Computer automatically measures and records temperatures continuously at dozens of points on walls, solar collectors, water-storage tanks; and records electrical power use and other operating conditions. It then decides whether heating or cooling is needed, which zones get it, and from what source. Computer runs house systems by controlling elaborate array of valves and dampers in complex switching center (below, left).



with it. That's the cheapest way to go, since all we have to spend is enough electricity to operate a fan to move the air and a small pump to move the water."

When the temperature in the storage tank drops below about 100° F, the heat pump goes into operation, extracting heat from the water until the temperature in the tank falls to about 50° F.

"The COP is still about 4.0 with a water temperature of about 50° F," says Bridgers.

"In addition," he continues, "we've added another circuit. On a sunny day when the temperature gets too warm in the office, you can extract heat from the air with the heat pump and store it in the tank, raising the water's temperature. Then at night, or later when we need it, we reverse the cycle and pump the heat back out. In the spring and fall we run that kind of cycle most of the time, cooling in the daytime and heating at night."

A variety of designs

In the past few years, a number

of innovative and interesting buildings have been springing up, many of them aimed at finding out just how the economics of this kind of heating/cooling plant work.

One example is a house in the Blue Ridge Mountains designed by Owen & Mayes Engineering of Lynchburg, Va. The 1600-square-foot house (with a 1000-square-foot basement) has 336 square feet of Sunworks collectors on the roof, a 2000-gallon concrete water-storage tank buried in the yard, and a York four-ton water-to-air heat pump. When water in the tank drops below 100° F, the heat pump cuts in. It can extract heat all the way down to 45° F, but a backup well that produces water at 55° F is available. When tank water drops to 55°, well water is used as a source from which to extract heat. In the summer, the 55° F well water is used to reject the heat from the house, which means that the air-conditioning cycle is far more efficient than the usual home air conditioner. The house has been operating now since the summer of 1976, and overall savings for heat-

ing, cooling, and domestic hot water seem to be running in the 65-to-70-percent range.

Putting the evaporator coil of the heat pump directly into a tank of solar-heated water is only one of the ways in which a heat pump might get a solar assist. In a study done by Westinghouse for the Electric Power Research Institute, more than two dozen possible ways of hooking up such systems were outlined. In one, for example, the heat pump had one evaporator coil in the tank of solar hot water and the other in outside air.

Owen & Mayes recently put such a system into the David C. Wilson Neuropsychiatric Hospital in Charlottesville, Va. "During the day when the solar system is collecting heat, we want to store it," says John Owen. "And our air temperature is in the 45-to-50-degree range a lot of the time. So we run the outside air coil. We're well above the balance point and get a good COP. Then at night when it gets cold outside, we use the water-source coil. This allows

Continued

Solar collector and heat pump: Is it a marriage made in heaven?

us to minimize the solar-collector system."

You could also design a system in which a heat pump would extract heat from the outside air and heat water in a tank when storage temperatures dropped below a certain level. As Dr. James B. Comly, manager of the Energy Sciences Branch at General Electric's Research and Development Laboratories in Schenectady, N.Y., says, "The whole discussion of where heat exchangers should go and where the heat pumps should go relative to the outside air, the house, the solar collector, and the storage tank, is a systems problem. And it does not have a definitive answer yet."

One way to start finding the answers is to use off-the-shelf hardware in the simplest possible way. General Electric researchers did just that a couple of years ago when they designed a system for a house in LaGrangeville, N.Y., designed by the nationally known architect, Harry Wenning. The large house—4000 square feet—has 1200 square feet of double-paned collectors on the roof and a 4000-gallon storage tank for solar-heated water.

Normally, the solar-heated hot water is used for heating. But two heat pumps—one for the first floor and one for the second—can operate as backups. Their evaporator coils extract heat from outside air. On extremely cold days when the outside air is too cold for the heat pumps and there isn't enough heat stored in the solar tanks to heat the house, backup resistive electric heat takes over.

A similar heating system has been installed in Dallas, Tex., where Dallas Power and Light has been experimenting with two identical houses on adjacent lots. One has totally conventional heat-pump heating and cooling; the other gives its heat pump a solar assist.

The heat-pump system is similar to that in the Wenning house.

When the outside temperature is above 45° F, the house is heated directly with solar hot water piped to a heat exchanger in the air-handling duct. When outside temperature drops below 45° F, the heat pump cuts in. Finally, as outside temperature continues to drop and eventually reaches the balance point where resistive heating would ordinarily be used, the solar-heated hot water is turned on again to supplement or take over for the now-inefficient heat pump.

Perhaps the most complex house system to date was built recently in Prince George's County, Md., funded jointly by the Department of Energy, a local utility, and the Electric Power Research Institute. In this house, the heat pump will be used to heat the water in the storage tanks when the demand on the local electric utility is low (generally late at night). It heats the tank until the water is hot enough to do all heating for the following day. From that point on, hot water is drawn from the tank and run through a heat exchanger in the air duct. If the sun shines the next day, solar collectors will help heat the stored water. The more energy they collect, the less the heat pump will have to run that night.

During summer, the heat pump will chill the water in the storage tanks at night, so that it can be used for air conditioning during the day. The solar collectors will be used then only for heating the domestic hot-water supply.

NASA's Tech House

Not all the solar-assisted heat pumps are turning out well. In 1975, NASA built what it called Tech House at Langley Research Center in Virginia. The 1500-square-foot, three-bedroom house went into operation in mid-1976. The house itself is heavily insulated and sealed.

But the main reason for its being

is its versatile heating and cooling plant. To begin with, it has a water-to-air heat pump that draws its heat from well water or a 1900-gallon water tank heated by 384 square feet of Chamberlain flat-plate solar collectors on the roof. When tank water is above 95° F, it is used to heat the house directly. When tank temperature falls below the level needed for direct heating, two one-ton heat pumps are used to extract heat from the tank or from well water.

During the summer cooling cycle, rejected heat is returned to the ground through the well. As an experiment, the rejected heat was stored in the 1900-gallon water tank during the day and returned to the air through special nighttime radiators. This proved impractical.

NASA engineers recently told me that they had found it far cheaper to operate the heat pump with well water as the heat source, and that the extra cost of the solar collectors could not be justified. If they were designing it again, they said, they would just use the solar hot water for direct heat and put the evaporator coils of the heat pump in outside air.

The result is not surprising. There is no doubt that in many parts of the country, under many different operating conditions, the solar-assisted heat pump, with its high initial cost, cannot be justified economically. Certainly in those areas with cheap gas available for heating, and perhaps in those with a good source of groundwater, there would be better ways of heating. But in other areas, with different conditions, economics, and perhaps different ways of hooking the components together, the final answer might look entirely different.

Whether this works out to be true, and if so, where, and under what conditions, is what we'll be learning over the next few years from engineering experiments now under way. PS

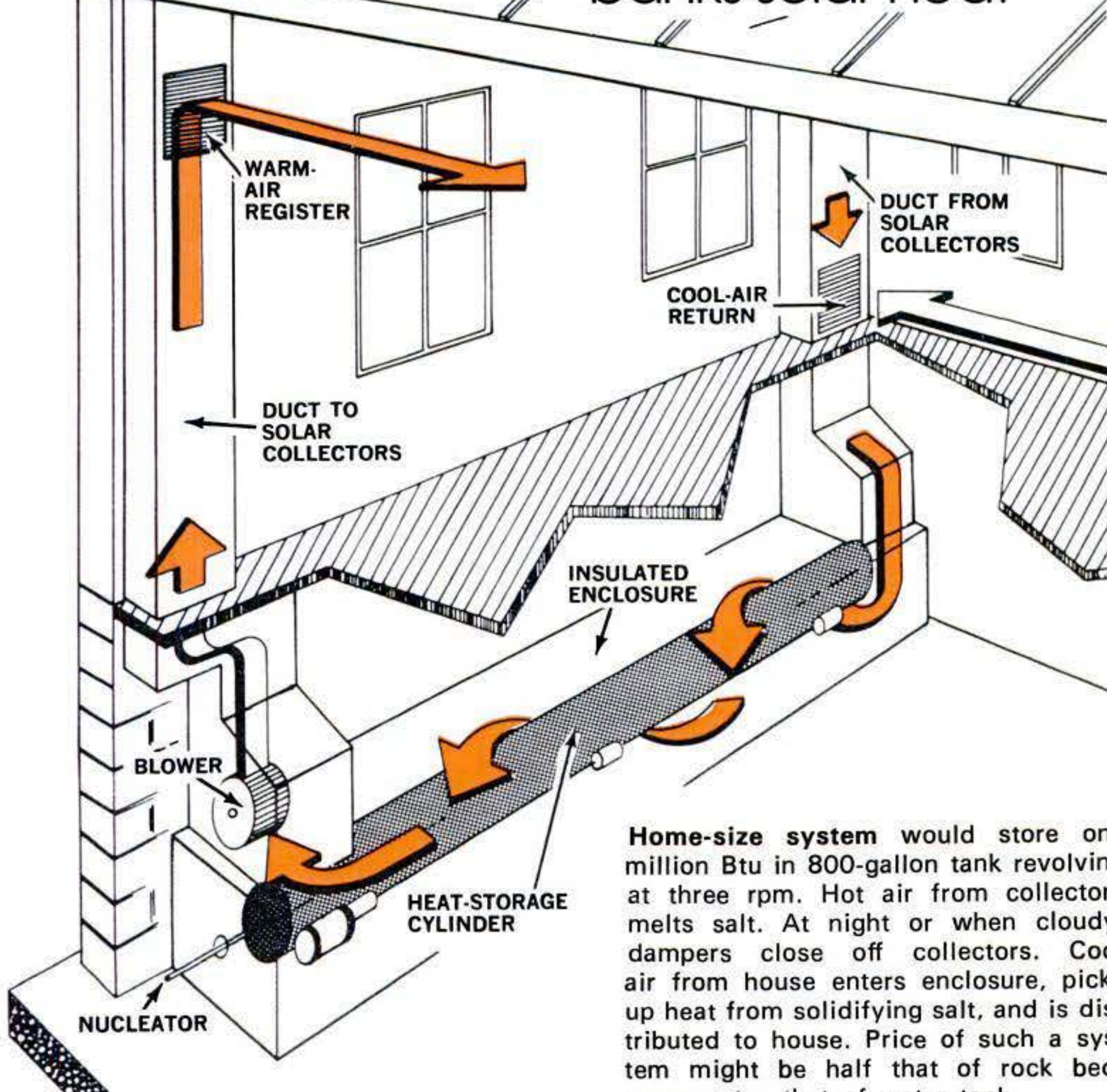
Who makes them?

Until now, most solar-assisted heat-pump installations have been individually designed by a few forward-looking heating and air-conditioning engineers from parts available on the market—solar collectors, water-to-air-pumps, and so on. Now, the major heating and air-conditioning companies are beginning to produce lines of pre-engineered systems designed for residential use that can be installed by their dealers around the country. So far, most of the systems are similar to the one installed in the Wenning house described in the text. They are relatively simple systems in which the two components—direct solar heating and reverse-cycle heat-pump operation with the evaporator coil in outside air—work in parallel. Such sys-

tems are made by Airtemp, Climatrol, and Fedders (all of Edison, N.J. 08817) and by General Electric (Central Air Conditioning, Appliance Park, AP6-228, Louisville, Ky. 40225). Carrier Air Conditioning (Carrier Parkway, Syracuse, N.Y. 13221) sells a similar system with one additional feature. Through the use of a special device called the Tri-X coil, the unit can use the air conditioner during off-peak periods (at night, for example) to chill water in the tank. The chilled water is then used the next day for air conditioning. Westinghouse Electric Corp. (Solar Heating and Cooling Systems, Skyline Center, Suite 201, 5205 Leesburg Pike, Falls Church, Va. 22041) uses principles similar to those described above, but Westinghouse incorporates solar collectors that use air as the working fluid and stones as the heat-storage medium.

Revolving barrel

banks solar heat



Home-size system would store one million Btu in 800-gallon tank revolving at three rpm. Hot air from collectors melts salt. At night or when cloudy, dampers close off collectors. Cool air from house enters enclosure, picks up heat from solidifying salt, and is distributed to house. Price of such a system might be half that of rock bed, one-quarter that of water tank.

A slowly turning cylinder filled with slush could keep you warm when the sun's not shining

By RICHARD STEPLER

Tanks of water and bins of rock—conventional ways to store solar heat—are big, heavy, and relatively expensive. Phase-changing salts, however, can store the same amount of heat in a much smaller mass, thus offering potential advantages in size and cost.

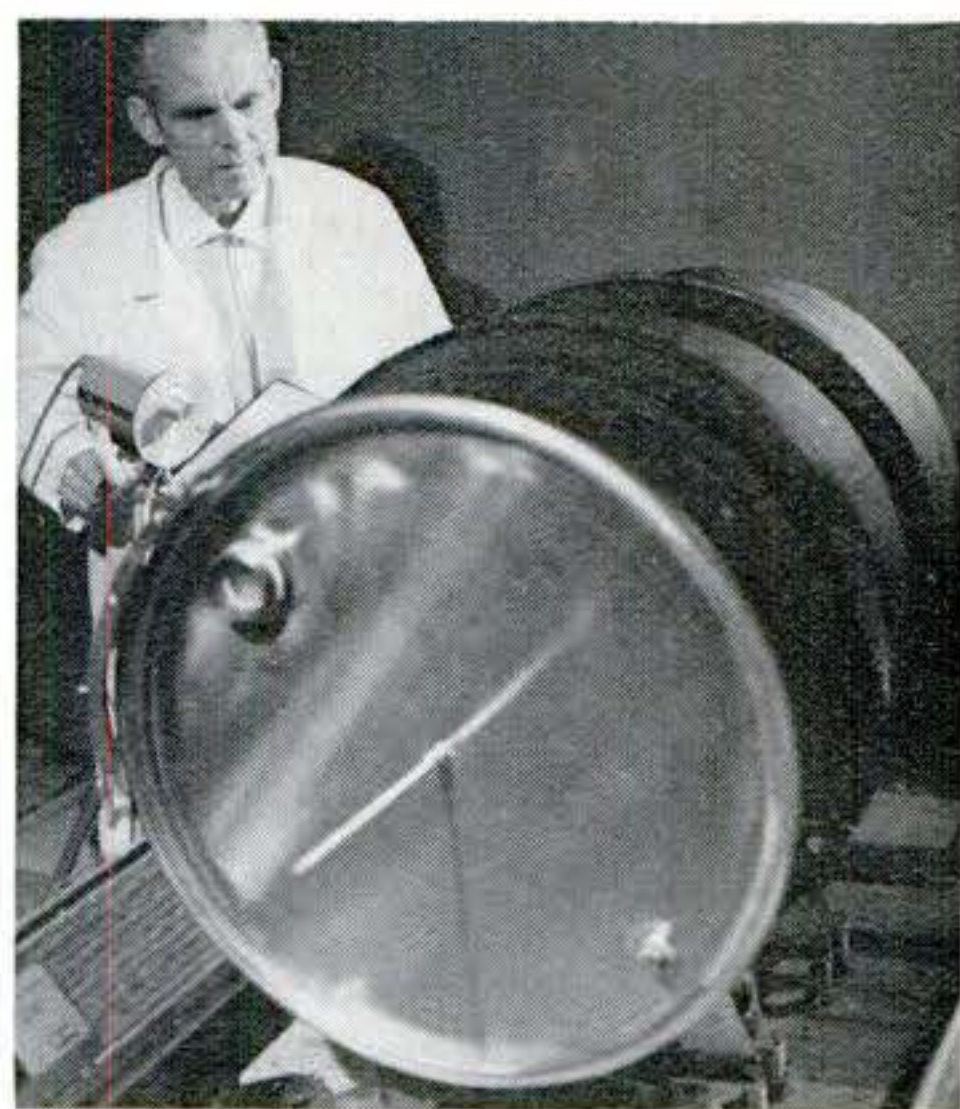
One such material is sodium sulfate decahydrate, better known as Glauber's salt and sold for a mere 1½ cents a pound. The use of this corrosive, sticky material as a solar-heat-storage medium has been unsuccessfully attempted for more than 30 years. Now researchers at GE's Schenectady R&D Center say that a "rolling cylinder" they've developed solves the problems.

The concept is simple: When a solid melts, it stores a large amount of heat; when it resolidifies, it releases the heat. In the case of Glauber's salt, this change of phase occurs at about 90° F, a convenient temperature to store solar energy for space-heating purposes. A pound of the salt stores 108 Btu when it melts, plus about 20 Btu as it rises 30 degrees. It takes four pounds of water or 20 pounds of rock to store the same 128 Btu for the same temperature increase.

Among the problems encountered previously with the salts:

- The material tends not to solidify completely, an effect called encapsulation. This reduces the salt's heat-storage capacity.
- The material tends to build up on the walls of its container, acting as insulation.
- The material supercools before it starts to solidify.

"Nature says, 'I don't want to crystallize. I'll stay liquid. I'll let you cool me down 40 degrees below



Revolving-barrel inventor Carlyle Herrick pours warm Glauber's salt into prototype tank in top photo. Electric heaters simulate solar input for 55-gallon tank in lower photo. Tank is filled to 95 percent of capacity with salt. Nucleator is ¼"-dia. tube that extends from center of cylinder. Tube contains salt seed crystals that initiate crystallization process.

my melting point before I start to solidify," explains Carlyle Herrick, GE chemical engineer and inventor of the cylinder. "Something must furnish the first crystal in order to get the freezing—and heat-release—cycle started."

The something in Herrick's cylinder is a tube filled with salt plus a chemical agent that causes high-velocity crystal growth. (With a patent still pending, Herrick's not naming the agent.)

The other problems are solved by turning the salt's storage container at three rpm. "This provides just enough stirring action to keep the temperature of the Glauber's salt uniform and very close to the wall temperatures," says Herrick. "Under these conditions, the material crystallizes on nuclei in the liquid and not on the cylinder walls."

A 55-gallon drum is the largest prototype to date. Herrick's R&D team is now embarking on a 30-month scale-up program under Dept. of Energy sponsorship. **P5**

Help for inventors

Innovation center gives cheap, expert advice

Got a better mousetrap?
For \$50, you can find out if it will sell

By DOUGLAS COLLIGAN

It was a simple idea. She had designed a set of flowerpots with one flat side each so they could be hung on the wall or used as bookends. Since she had no experience as an entrepreneur, she went to an invention-development company—a professional-looking outfit with branch offices across the U.S.

An "idea broker" there examined

her idea, said it had potential, and offered her an invention-development contract. The company would provide professional drawings of her idea and promote it to manufacturers. The inventor signed the contract, paid the \$1500 fee, and waited. But other expenses followed: fees for market-analysis studies, patent searches, and patent applications. By the end of several months, the inventor had spent \$3000. All she had to show for it was a large pile of paper, two flowerpots, and one patent—from the Canadian patent office. And that was practically worthless outside of Canada,

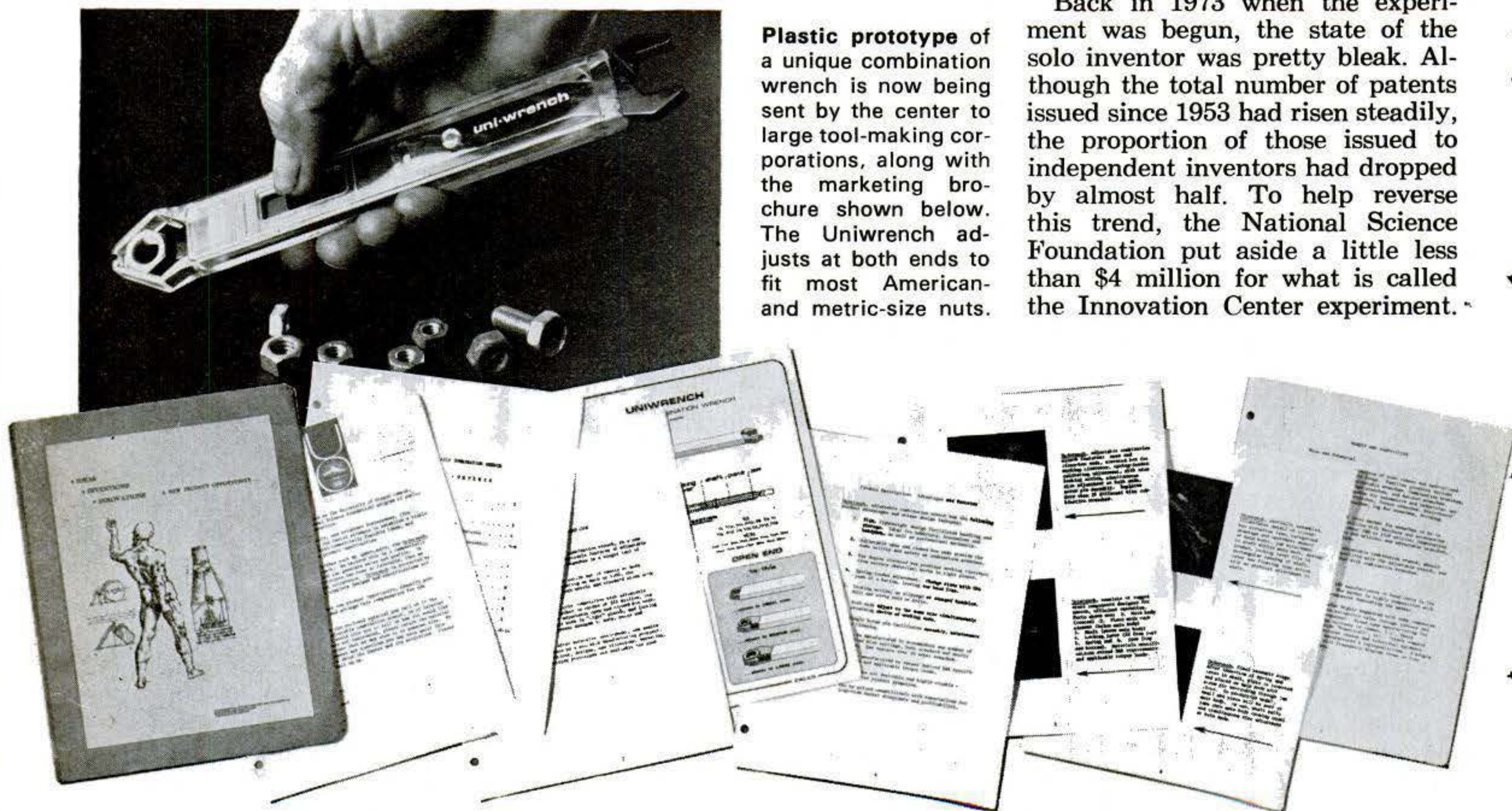
according to a lawyer for the New York attorney general's office, which is investigating the firm.

The woman could have saved \$2950 and still gotten more for her money if she had known about the University of Oregon's Innovation Center. There a team of experts evaluate ideas for a \$50 fee and tell the inventor how likely the idea is to succeed.

This service is one result of a three-part experiment by the National Science Foundation. Its goal: to preserve that rare breed of thinker, the independent inventor, from near extinction.

Back in 1973 when the experiment was begun, the state of the solo inventor was pretty bleak. Although the total number of patents issued since 1953 had risen steadily, the proportion of those issued to independent inventors had dropped by almost half. To help reverse this trend, the National Science Foundation put aside a little less than \$4 million for what is called the Innovation Center experiment.

Plastic prototype of a unique combination wrench is now being sent by the center to large tool-making corporations, along with the marketing brochure shown below. The Uniwrench adjusts at both ends to fit most American- and metric-size nuts.



Slick marketing brochure features market analysis of Uniwrench's viability, description of wrench, color photos, profes-

Three schools—the Massachusetts Institute of Technology, Carnegie-Mellon University, and the University of Oregon—were given part of this money to set up three different kinds of innovation centers.

MIT and Carnegie-Mellon channeled their funds into special teaching programs for their students, giving them the skills to develop and market new ideas. Dr. Gerald Udell, director of the University of Oregon's center, decided to use the funds to offer a public service to all independent inventors. Udell wanted to develop a cheap and efficient way to evaluate the promise of an inventor's idea and to give guidance for further development.

"To put it bluntly," Udell said, "we want to keep people from getting ripped off by idea brokers." A highly energetic man, Udell gets tremendously excited and indignant about the brokers. "Anyone who accepts that kind of up-front money—fees of \$1000 to \$2000—without doing a meaningful evaluation is automatically suspect in my book," he says.

That suspicion is shared by the Federal Trade Commission (FTC),

ventions. Another FTC investigation in California found that of the 30,000 clients who paid a firm similar fees, a grand total of three had successful inventions.

Last year the two largest idea brokers in the country were targets of five lawsuits filed by the FTC and the attorneys general of New York and California. The firms were accused of using deceptive advertising practices in promising all kinds of help and then seldom giving it once the inventors paid the fees.

Seeking a more honest alternative, Udell and his staff decided to design an evaluation system broad enough to adapt to just about any invention, but specific enough to make it valuable to the inventor. The concept is not new. Many corporate R&D departments use some kind of formal or informal evaluation in judging new ideas, but as Udell and his co-workers discovered, none was general enough for their purposes. After making a thorough study of the more than 200 evaluation systems already in existence, the Oregon group designed its own.

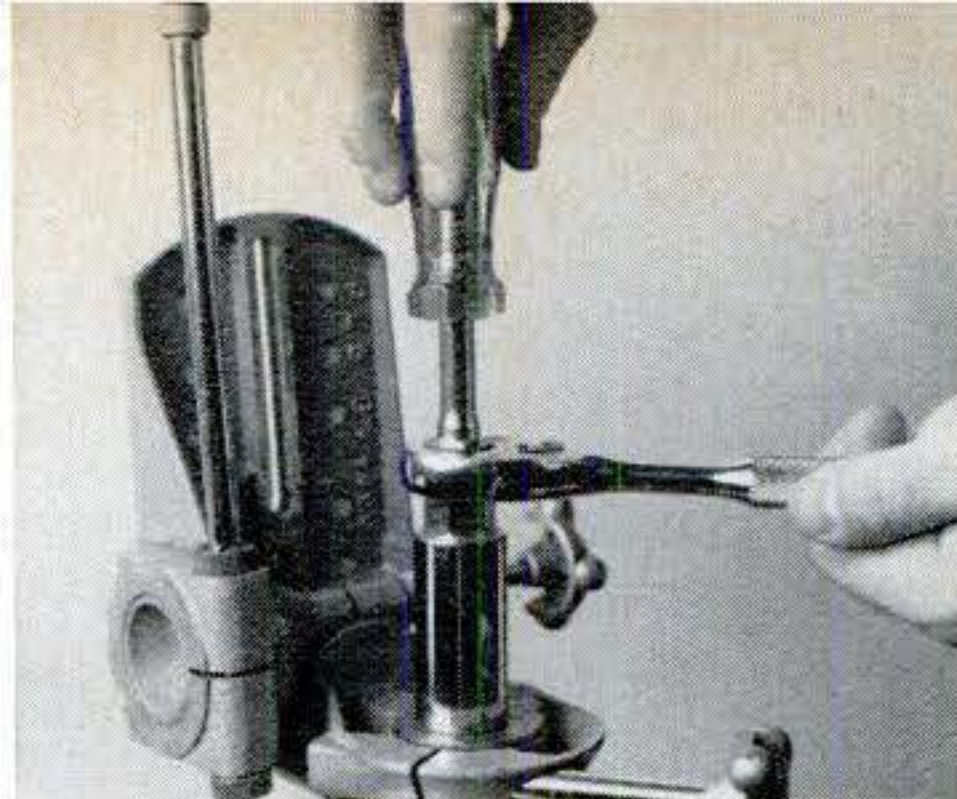
The result is a 33-point computer program that's an extremely sophisticated profile of what can make or break an invention. The evaluation covers five general areas:

- Society: Is the idea safe for and beneficial to society?
- Business risk: Is the idea likely to make a profit?
- Demand: How much of a need is there for the idea?
- Market acceptance: Will enough people want it?
- Competition: How extensive and how tough will it be?

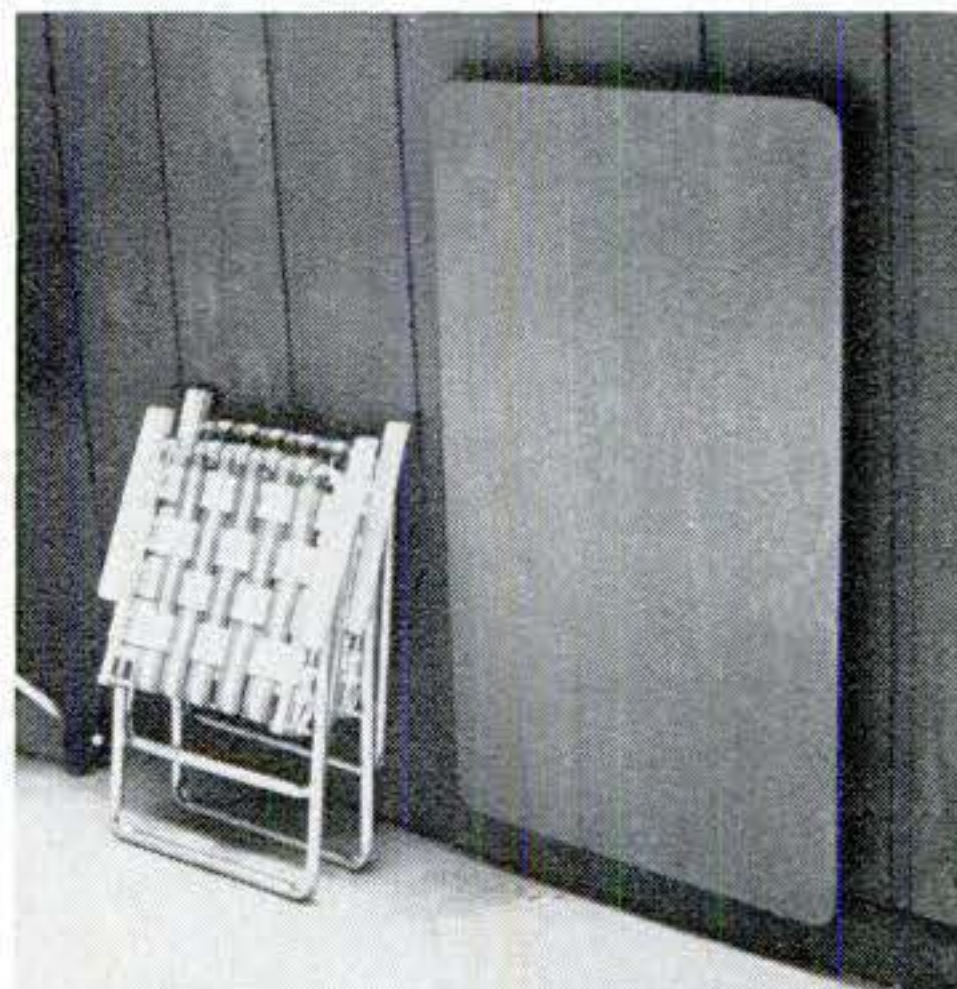
The evaluation process itself is uncomplicated but thorough. Each idea submitted is handled by a

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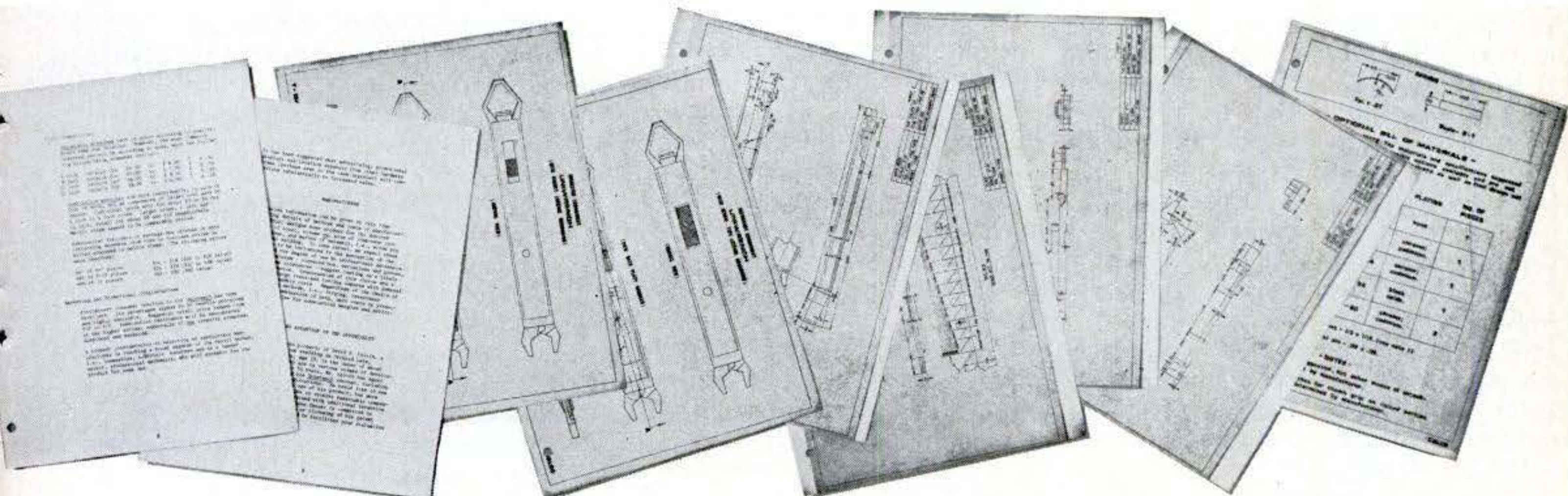
which has been investigating the \$100 million invention-development industry. One of its findings: While the firms are very good at taking inventors' money, they're not so good at developing successful inventions. In an investigation of one firm, the FTC found that although 35,000 clients had paid fees ranging from \$1000 to \$2000, only 10 ever made any money from their in-



Practical duo—a speed handle and a ratchet wrench—is now being promoted by the center. The handle both steadies the wrench in tight spots and speeds up the process of starting or removing nuts.



Space-saving, full-size table (above) folds flat to the wall (top). A Minnesota furniture company paid the table's inventor \$65,000 for rights to the design. He could get \$200,000 more in royalties.



sional drawings, and patent information. Center prepares similar brochures for most inventions with market potential.

team of three to five evaluators. The team approach, Udell says, helps eliminate personal bias and produces a more objective evaluation.

The evaluators may be on the university faculty, experts from the Western Inventors Council (a non-profit organization set up to assist independent inventors) or highly skilled students.

"We do not turn ideas over to undergraduates or inexperienced students," Udell is quick to explain. "The average age of these student evaluators is about 32—they are professional people who happened to come back to school."

To simplify the evaluation procedure, each team member fills out a printed form that has a multiple-choice breakdown of each of the variables. For example, the evaluation-form entry for investment costs reads:

"The amount of capital and other costs necessary for development to the market-ready stage would be:

- ☐ Greater than returns—should be dropped.
- ☐ Excessive—might be recoverable.
- ☐ Heavy—probably recoverable.
- ☐ Low—recoverable within two years.
- ☐ Don't know.
- ☐ Not applicable."

The evaluator checks off the appropriate statement and can add a written explanation. Completed forms are fed to a computer, which compiles their findings. The resulting computer printout, along with an explanatory booklet and any written comments is sent to the inventor.

Anyone who has an idea for an invention can have an evaluation done. Just request a copy of the Innovation Registration and Disclosure Booklet from the Innovation Center (131 Gilbert Hall, College of Business Administration, University of Oregon, Eugene, Oregon 97403). Fill in the booklet and send it back with \$50 and any available mechanical drawings, sketches, photos, or explanatory information. "Generally, the more detailed the information supplied," said Udell, "the more thorough the evaluation."

Your idea doesn't have to be at a highly advanced stage—no working models or prototypes are necessary, for example—and it does not have to be patented. In fact, Udell recommends against automatically getting a patent. "It's in the inventor's best interest to get some input before deciding whether to

get a patent," Udell says. "It just doesn't make sense to get a patent and then determine if an idea is commercially feasible—especially since a patent can cost hundreds of dollars."

How ideas fail

Besides saving the inventor from wasting money patenting a doomed invention, an objective evaluation can also save him from wasting precious time. As an example, Udell describes a device designed to circulate the heat from four gas-stove burners around the inside of a recreational vehicle. The inventor had spent 20 years of his life and about \$15,000 of his own money on the idea—and had even developed a prototype that worked beautifully.

Unfortunately it had some serious flaws that hadn't even occurred to the inventor. "It was a nice prod-

“After all, it wasn't a corporation that came up with the telephone, light bulb, and airplane”

uct functionally and would have done the job," Udell said. "But it would have also killed a fair number of occupants in an inappropriately ventilated vehicle." The man had to be told he had wasted time and money on an idea that was doomed from the start.

Few inventions reach the Innovation Center in such an advanced state, but many do get the same kind of verdict. In general, Udell estimates that of every 100 ideas submitted for evaluation, about 85 have too many faults to be successful. Of the remaining 15 with some potential, perhaps five might get produced. Of these five, one might turn a profit for its inventor.

A number of factors can murder even the best idea. Between 50 and 80 percent of the new products introduced each year fail—often for simple business miscalculations. Even the most experienced have failed—General Electric, for example. The Innovation Center's literature describes how GE failed to successfully market a new line of Christmas tree lights. The bulbs had a frosty white coating that muted the underlying colors. Most customers thought the bulbs were all white and, consequently, wouldn't buy them.

To head off such commercial dis-

aster, the center's staff will help an inventor develop and market an idea they think has promise. This service is performed for a percentage of royalties, or for a negotiated fee. In general, the center sees two types of promising ideas: *transferable* inventions, suited to the special needs of a large corporation; and *marketable* ideas that could be the foundation of a small business. Marketable ideas, according to Udell, can produce enough money to make a profit but not on a scale large enough to appeal to large corporations. "There are companies that won't touch an idea that can't produce \$5 million in sales," Udell explains, "simply because they can't make money on something that generates any less."

Two money-makers

In spite of the odds, some ideas that the Innovation Center evaluated did turn out to be profitable. One marketable concept became a modest success as Rare Ore, Inc.

A group of enterprising students had dreamed up the idea of selling low-grade gold ore. They bought up ore that contained too little gold to be worth processing, packaged it, and sold it as a novelty item. The Rare Ore venture was successful enough to help pay for the costs of college and then some.

On a slightly larger scale, the Innovation Center evaluated and helped promote an idea that was perfect for technology transfer. It's a unique hinge design that makes a wall-mounted table fold back almost flush against the wall (see photos). According to Dick Bue, spokesman for SICO, Inc., the Minnesota furniture company that bought the design, "The table is ideal for small apartments and other places where space is scarce. When folded down and out of the way, the table protrudes less than an inch from the wall." As a result of licensing fees and royalties, the inventor could make a substantial profit.

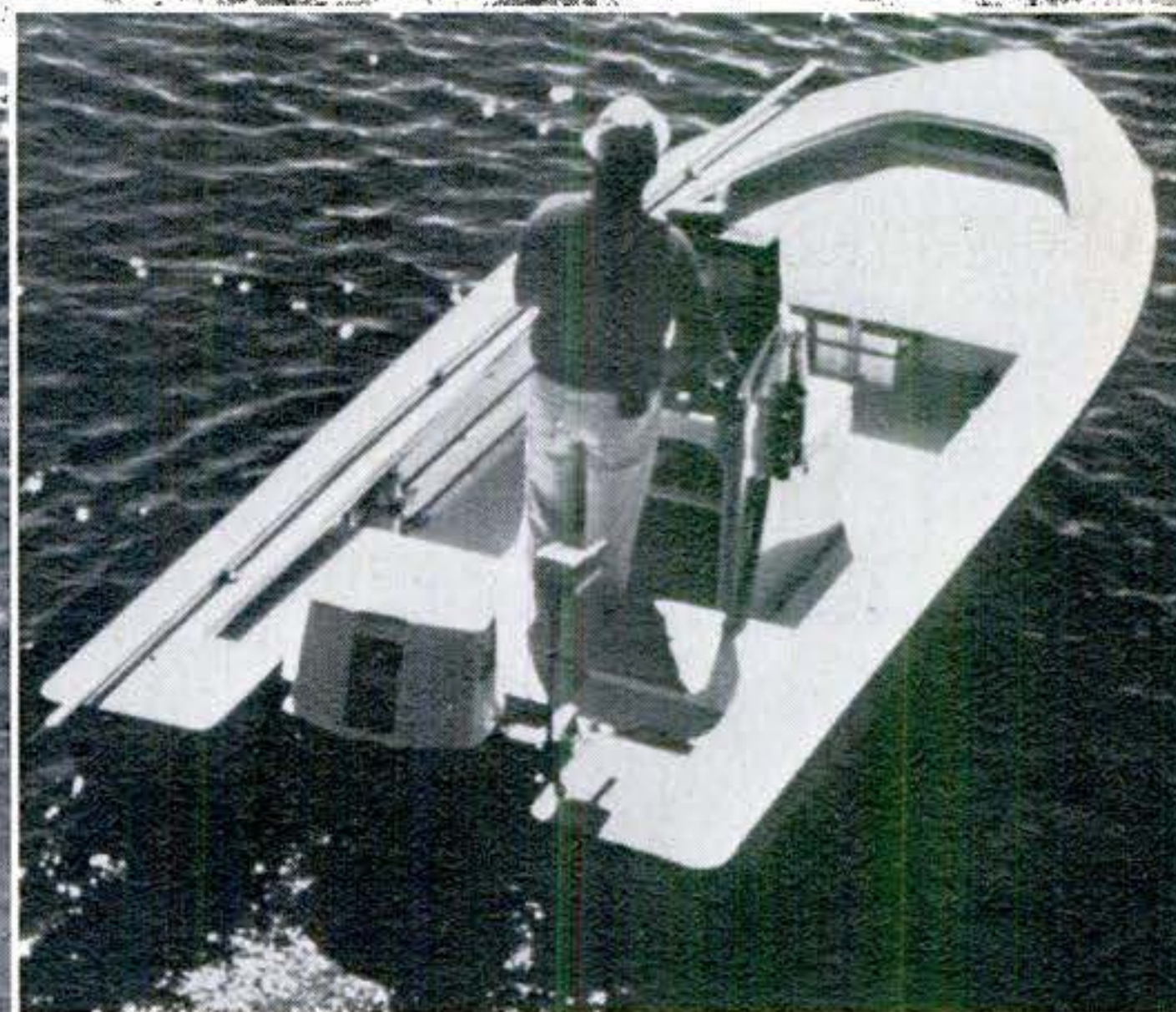
Not all devices or ideas that pass the evaluation process end up making money. One invention thought to have promise was a gadget designed to cure bedwetters by behavior modification. It was a small sensing device a child could strap on before going to sleep. As soon as the device sensed the first drops of urine, it would set off an alarm and wake the sleeper. It was cheaper, simpler, and much more effective than comparable products and had every indication of success. The

[\[Continued on page 182\]](#)



Fiberglass vs. Kevlar

PS pits the new hull material against the old standby



Our tests show that a Kevlar boat is lighter, quieter, and easier on fuel

By **BOB STEARNS**

There's growing interest in Kevlar boats because the new fiber promises many advantages over fiberglass. Do all those big claims really stand up, though, when you actually build a boat with Kevlar?

To find out, I decided to duplicate a fiberglass boat I own—using new Kevlar 49 reinforcing in place of the old standby material. Then, using the data I've carefully collected since 1969 on the fiberglass model, I compared its performance with Kevlar.

I've owned two 17' 8" Hewes Bonefishers—special shallow-water open fishermen—for the past eight years. The boat builder, Bob Hewes of Miami, Fla., agreed to help me with the test. Hewes has used the same molds since he started building this boat, except for some modifications of the center control molds, so an exact duplication was easy.

If we'd simply substituted Kevlar

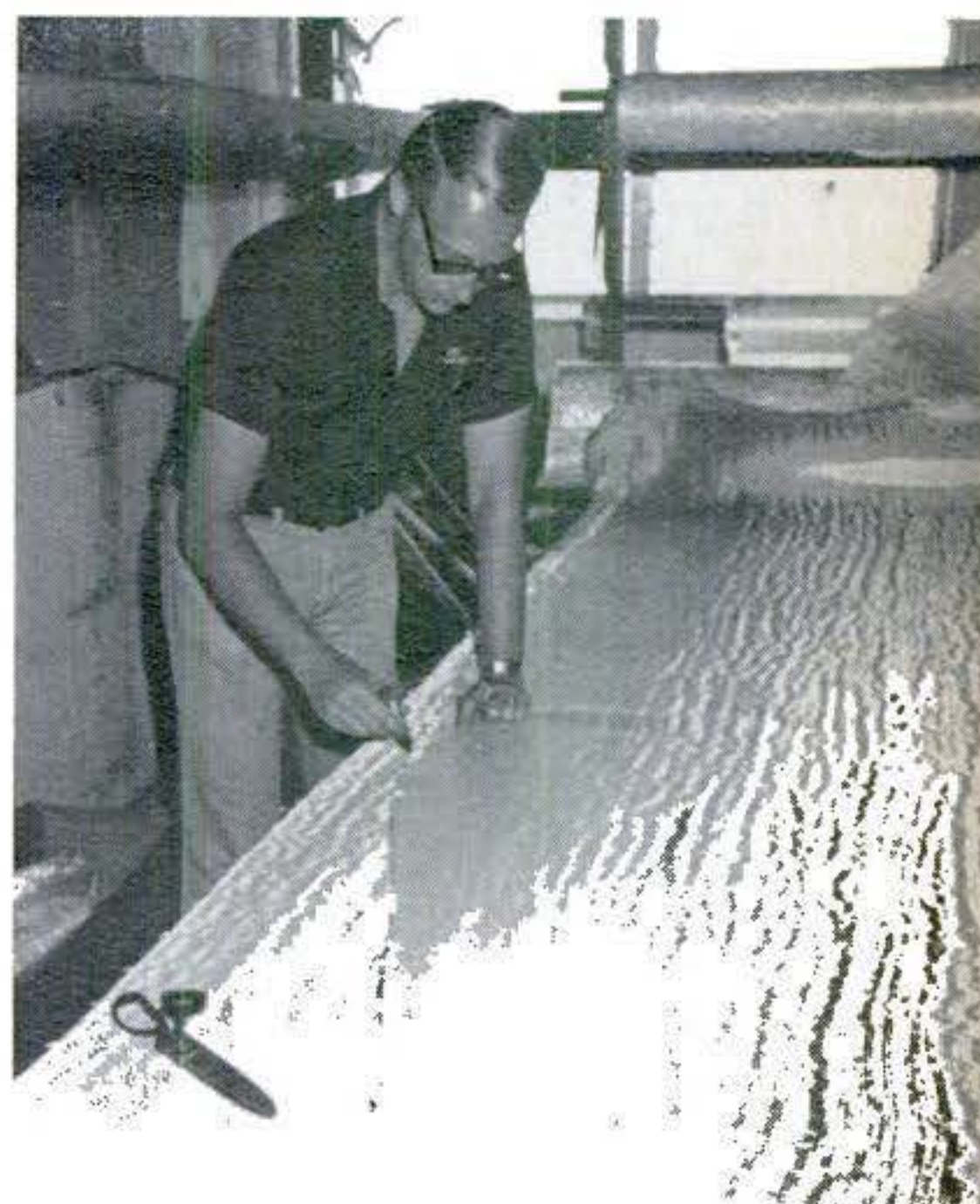
for certain layers of fiberglass in a low-profile boat like the Bonefisher, we'd have gained a weight saving of only eight to 10 percent. So we asked Dr. Robert Dainton of Du Pont's Kevlar Special Products Division to design a lay-up that would produce a greater weight saving without sacrificing hull strength.

Dr. Dainton recommended a hull laminate consisting of three layers of 1/2-oz. chopped-strand fiberglass mat (CSM) sandwiched alternately with two layers of 15-oz. Kevlar woven roving. The original hull in fiberglass was a composite of four layers of 1 1/2-oz. CSM and three layers of 24-oz. woven roving. We expected the Kevlar-reinforced version of this hull to have approximately the same strength as and somewhat more stiffness than the fiberglass boat, though the material would be only 60 percent as thick as the original glass hull.

A big bonus for the Kevlar version is its ability to withstand fatigue—a serious limitation of fiberglass hulls. That's the main reason why most quality fiberglass hulls are "overbuilt"—more material than is actually needed for strength is

Continued

High-flying Kevlar boat is piloted by author, who gave it repeated rough tests. Kevlar Bonefisher weighs 140 lbs. less than fiberglass original (inset) with same 85-hp engine; with 75-hp engine and smaller battery it's 252 lbs. less.



Hull laminate was designed by Dr. R. Dainton of Du Pont, who's laying out pattern on Kevlar 49 woven roving. Cutting took a little longer than with fiberglass.

Fourteen separate molds are required to build a Hewes Bonefisher. Kevlar 49 was used only to reinforce the hull, gunwale, and inner liner. All other components were constructed entirely of fiberglass (with wood backing where needed) in the same manner as the standard fiberglass version of the boat. A few more pounds could have been saved if Kevlar reinforcing had been used in all of the components, but the 800-to-1000-times higher cost made it economically unfeasible.



Fiberglass vs. Kevlar 49

	Fiberglass	Kevlar 49
Relative tensile strength	1.0	1.9 - 2.0
Relative weight	1.4	1.0
Relative stiffness	1.0	3.0
Approximate number of cycles for fatigue failure, heavy stress*	100-1000	10,000-100,000
Approximate number of cycles for fatigue failure, moderate stress*	1000-10,000	More than 10 million

A black and white photograph showing a person in a white tank top standing next to a large, curved structure, possibly a boat hull, which is covered in a thick, white, textured material. A bucket is visible in the foreground.

layer of Kevlar goes on. Three layers of CSM, two of Kevlar form sandwich.

higher with the Kevlar hull (see table).

The Kevlar boat with a Johnson 75 was able to attain the same top speed as the glass hull with the 85, at a considerable improvement in fuel economy. The reason? The three-cylinder 75 weighs 62 lbs. less than the four-cylinder 85, thus bringing the weight reduction up to 202 lbs. Also, the lighter boat/motor combination meant we could get sufficient thrust from a 12-V electric trolling motor—instead of the 24-V system required with the fiberglass/85-hp rig. The lighter battery chopped another 50 lbs. off our weight.

The fiberglass/85-hp rig delivered the best fuel economy when cruising at 3500 rpm. The boat went 21.90 mph, the engine burned 4.64 gph, and I was able to get 4.72 mpg in no wind/current conditions (all testing was done at the Miami Marine Stadium). In the overall cruising range of 3500 to 4500 rpm for the 85, the Kevlar boat realized an average 4.6 percent increase in fuel economy. But, by switching to a 75 on the Kevlar boat, my fuel economy in the 4000-to-5000-rpm cruising range rose to an average of 41 percent better than that of the 85 on the fiberglass boat—and without any sacrifice in speed and performance (see table).

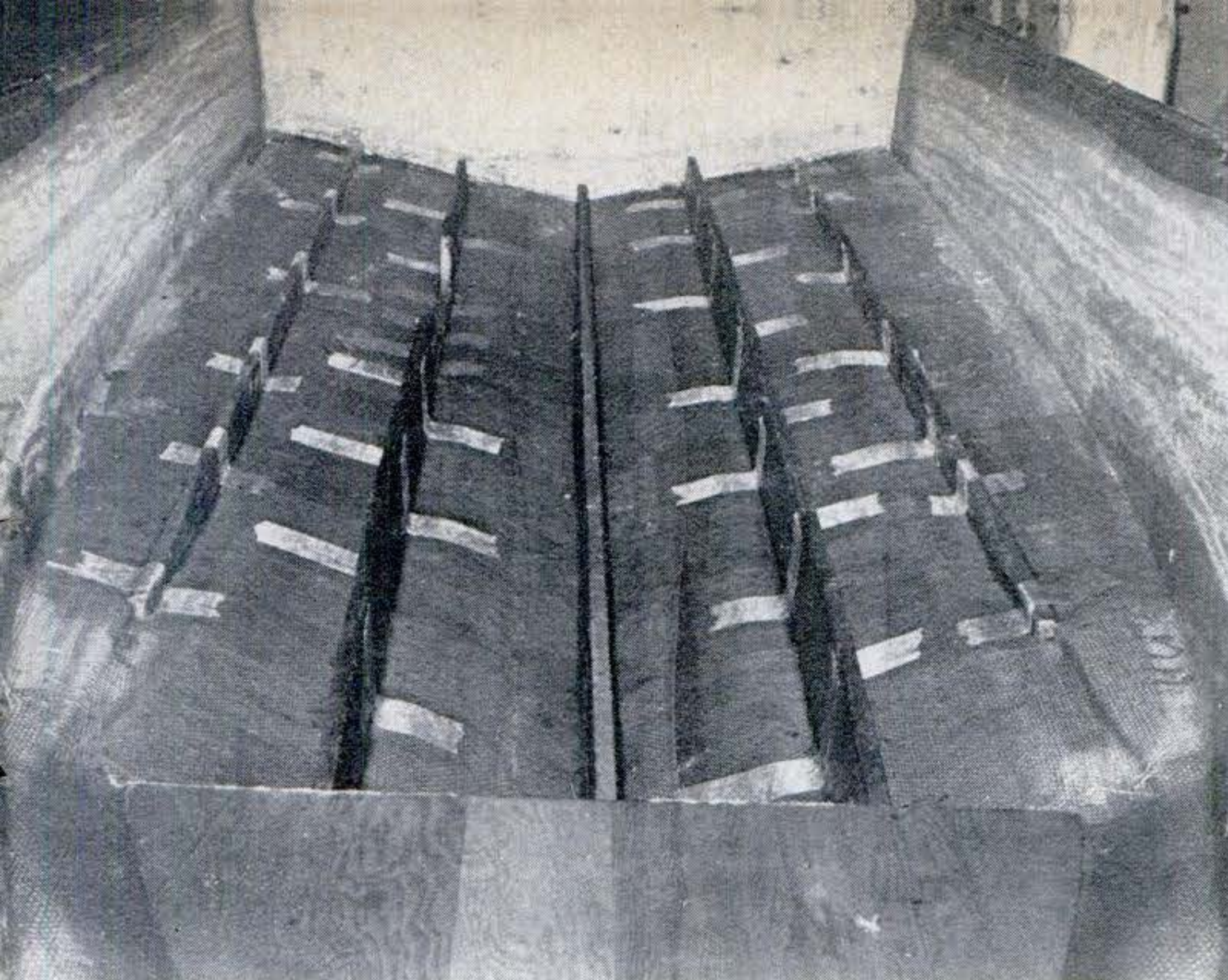
Comparing costs

Hewes estimates that the additional cost of a Kevlar reinforced Bonefisher (which he calls the Su-

Performance comparison: Fiberglass vs. Kevlar Bonefisher

1975 Hewes Bonefisher, fiberglass, with 1977 85-hp Johnson				1977 Hewes Bonefisher, Kevlar, with: 1977 85-hp Johnson								1978 75-hp Johnson			
RPM	MPH	GPH	MPG	RPM	MPH	GPH	MPG	RPM	MPH	GPH	MPG				
1500	5.14	1.72	2.99	1500	5.16	1.71	3.02	1500	4.21	0.92	4.58				
2000	6.76	2.45	2.76	2000	6.92	2.46	2.81	2000	5.80	1.26	4.60				
2500	11.11	3.46	3.21	2500	11.77	3.46	3.40	2500	7.24	2.23	3.25				
3000	16.67	4.17	4.00	3000	17.26	4.20	4.11	3000	9.97	3.21	3.11				
3500	21.90	4.64	4.72*	3500	22.88	4.63	4.94*	3500	18.36	3.31	5.55				
4000	27.27	5.84	4.67	4000	29.05	5.90	4.92	4000	23.17	3.36	6.90*				
4500	31.25	7.50	4.16	4500	32.45	7.51	4.32	4500	27.31	4.33	6.31				
5100	35.79	9.27	3.86	5200	37.81	9.36	4.04	5000	30.12	5.11	5.89				
								5500	34.23	7.03	4.87				
								5700	35.86	7.89	4.54				

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Hull is now almost completed. Note that stringers have been locked in place with

strips of 3-in.-wide Kevlar unidirectional fiber tape at 16-in. intervals.

per Bonefisher) is around \$360.

How about net cost to the user? If you use a smaller engine, as I did, the initial cost difference between engines is about \$200. This reduces the total package price difference between Kevlar and fiberglass to about \$160. If I run that 75-hp engine at cruising speed for a total of 100 hours per year, I'll use approximately 355 gallons of gas as compared to about 500 for the 85 on the fiberglass boat. At the current cost of gasoline and outboard oil, my net savings would be about \$125. So by the end of one year, the total cost difference between the two rigs would be just \$35. And since fuel costs will continue to rise in the foreseeable future, the lighter, more efficient rig will actually save me quite a bit in operating costs over the years.

Lifetime and strength

This still leaves two questions unanswered: How long will a Kevlar-reinforced boat last when compared to fiberglass, and is the Kevlar hull, with its lighter construction, as strong as fiberglass?

Kevlar 49 has been used in boat construction since 1973. The first boats were canoes and kayaks, which thus far have proved to be far tougher than either aluminum or fiberglass on a weight-for-weight basis. Kevlar is used by 25 canoe and kayak manufacturers.

Fatigue failure is the most common problem with fiberglass hulls. Fiberglass has a poor ability to

withstand constant flexing under moderate to strong load conditions, such as the constant pounding of a choppy sea or the bouncing up and down of a trailer bed on the road. Kevlar, according to lab tests which thus far seem to be supported by limited field use, can withstand thousands of times more flexing than fiberglass without failing (see table). At the moment all indications are that a properly constructed Kevlar-reinforced hull should outlast an equivalent all-glass hull by a wide margin.

How about strength? Kevlar's popularity in ocean racing has grown so rapidly that it has become the standard by which all other hull-construction techniques are judged. In the deeper-hulled boats used for racing at speeds above 85 mph in seas that often top 10 feet, Kevlar can save up to 30 percent of the gross hull weight. That means more speed with the same horsepower.

For over a year, Kevlar hulls have won almost every major ocean race in which they have been entered. Also, there hasn't been a single hull failure reported to date, even though in those same races there were numerous hull failures with heavier fiberglass boats!

If damaged, Kevlar-reinforced hulls can be repaired with any of the same materials used to patch fiberglass. The same resins are used in the construction of both, and a damaged Kevlar hull can even be patched effectively with fiberglass



Inner liner (here laid up by workmen) is made up of CSM and five-oz. Kevlar cloth. This lay-up was also used for gun-wales of Kevlar Bonefisher.

cloth or roving if Kevlar 49 patch material isn't handy. Epoxy resins and putties will also adhere as well to Kevlar as to fiberglass.

One major difference, though, is the feel of a Kevlar-reinforced hull. Most noticeable is the quietness, a result of Kevlar's ability to damp vibration and absorb sound. Even the typical fiberglass resonance caused by waves lapping against the hull while at rest is absent. The wave noise is still there, but it is considerably attenuated and not nearly as objectionable to a noise-conscious angler.

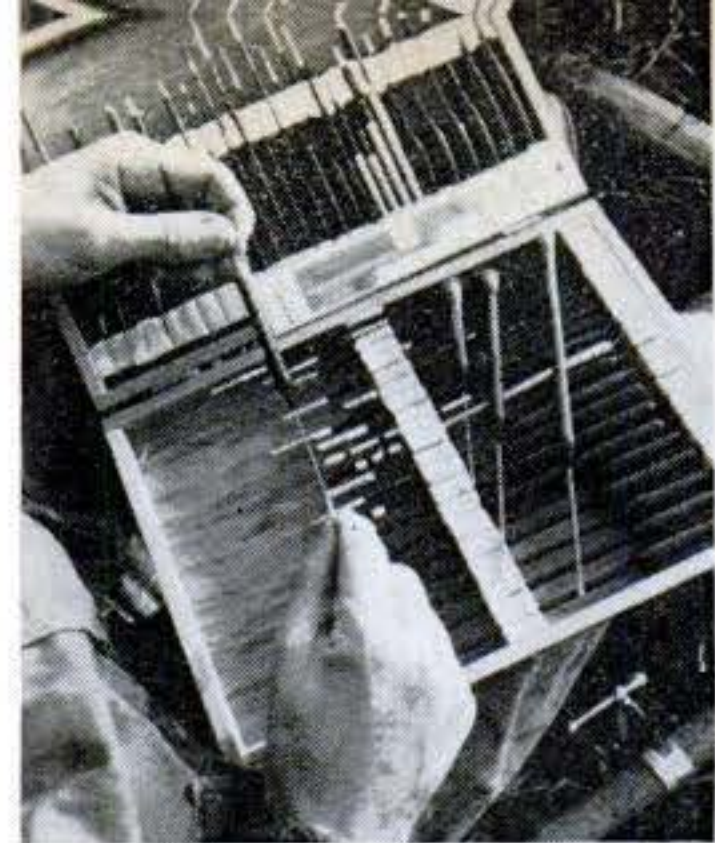
When I ran my Kevlar Bonefisher for the first time, I was most struck by the sharp reduction of noise levels while under way. For the first time I was able to hear loose gear rattling around in the lockers, something I'd never noticed with its fiberglass predecessor.

Even when pushing the hull hard into choppy seas or across large boat wakes—situations where I normally would have throttled back a bit—the ride was both quieter and smoother than I expected, and a definite improvement over the same hull in fiberglass.

What does the future hold for Kevlar? Looking back some 25 years or so, I recall the skepticism of many manufacturers about the suitability of fiberglass as a boat-building material. Time and technology overcame all of those objections, as I'm sure they will with Kevlar in a variety of practical applications—including boats. **ES**

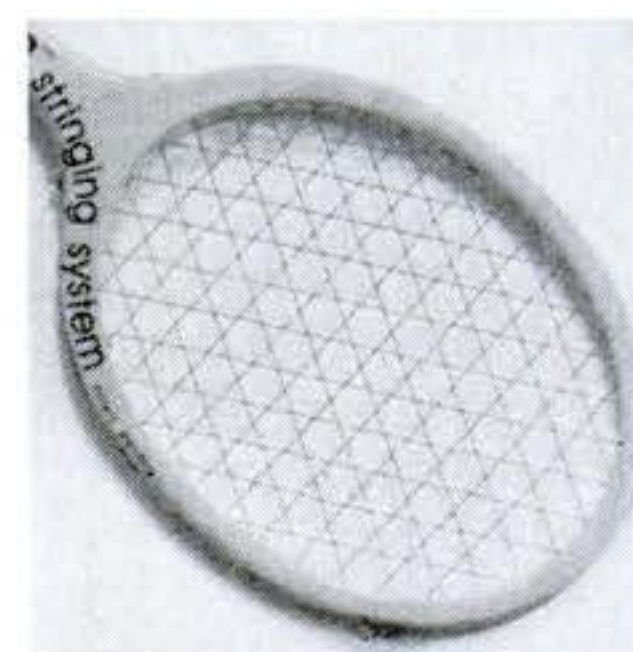
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Needle floats

Want to land more fish? Just attach these needle floats and pin weights to your lines, says the British manufacturer. Plastic cleats and a nylon spring latch let you put on floats in 10 seconds. Newark Needle Floats, Manor House, N. Muskham, Newark, Notts., England.



Convertible

Remove Skima 12's fiberglass hood or optional soft top and the 21-ft., 12-person hovercraft becomes a work boat with a one-ton freight capacity. A 250-hp Chevrolet V8 drives the lift fan and ducted propeller. It's made by Pindair Ltd., United Kingdom.

Radial racket

Geostar's radial racket-stringing pattern boosts tennis-ball-to-string friction 60 percent for better control, delivers more power, and has a larger "sweet spot," says the developer, Aec-Able Engineering Co., Inc., Box C, 350-S S. Kellogg, Goleta, Calif. 93017.



Speedy sailer

A huge sail supported by two outrigger-like hydrofoils gives this vessel—dubbed a monomaran—lots of speed, say its inventors, Frank Delano and Bernard Smith, Acorn, Va. 22420. The rudderless hull is steered with a lever that controls hydrofoil angles.

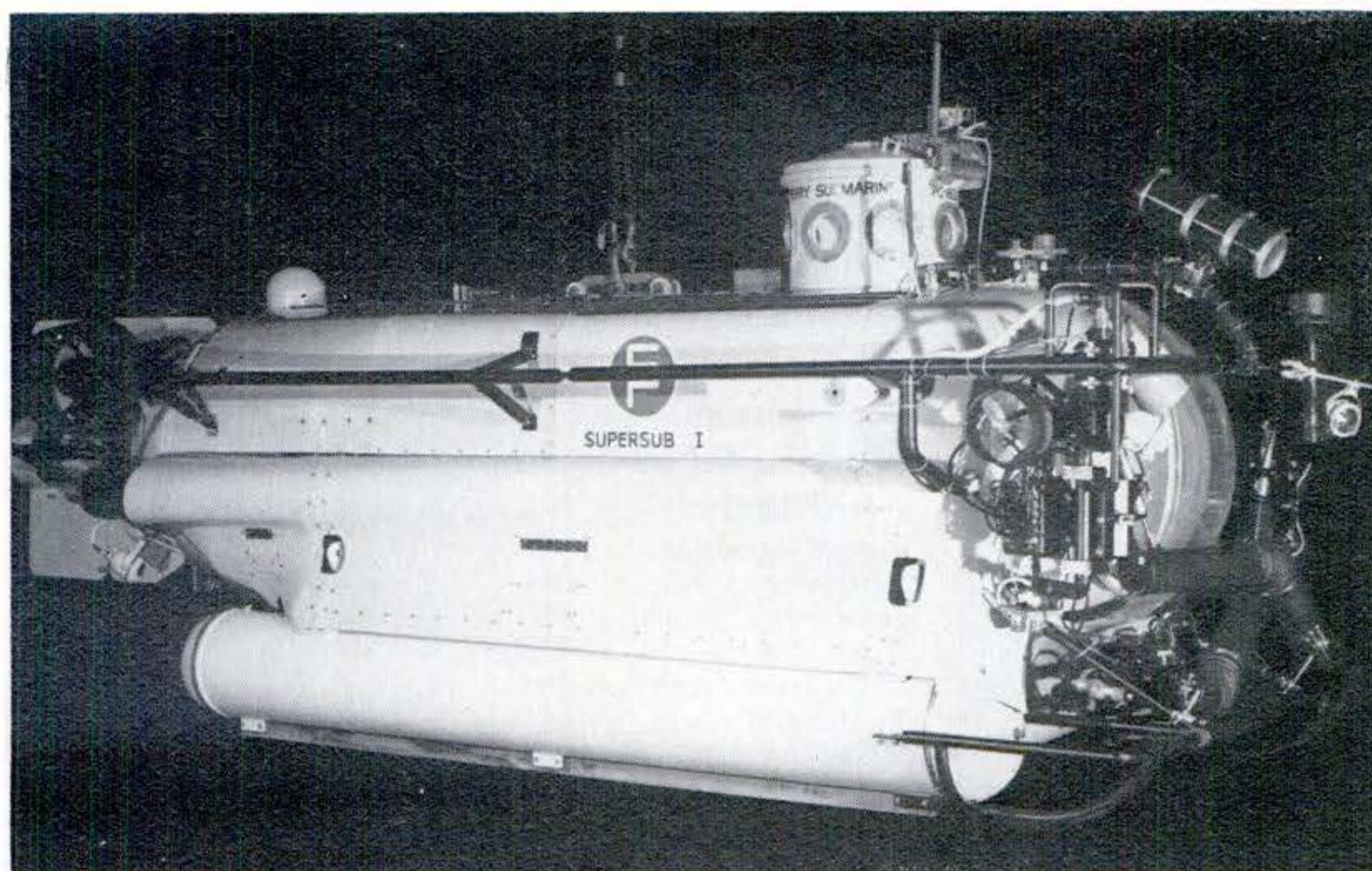
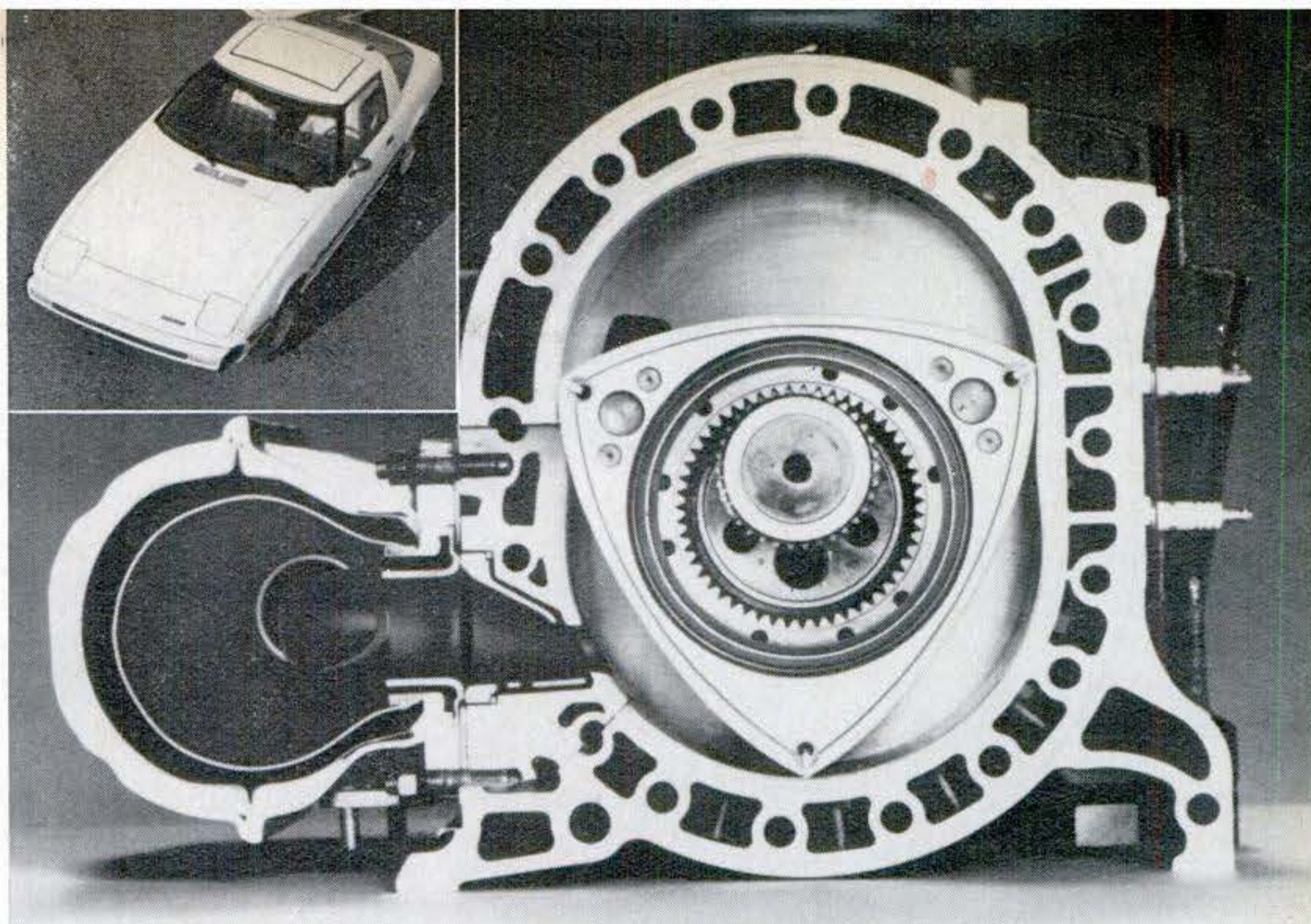
Fold-up cells

A foldable solar-cell panel will simplify recharging combat-radio batteries in the field. This version, built by Solarex, Inc., for the Army, weighs 3½ lbs. and fits in a standard backpack. In full sunlight the panel produces 24 volts at 0.8 amps.



Rotary-powered sports car

Can the Wankel engine make a comeback here? Mazda's betting it can with its new high-performance RX-7, a sporty two-seater that's due here this month. The RX-7 has an improved twin-rotor 12-A engine. Maximum net SAE hp is 100 at 6000 rpm. Maximum torque is 105 at 4000 rpm, and top speed is over 120 mph. EPA fuel rating is 23 mpg for combined city and highway driving. The RX-7 is 169 in. long, 49 in. high, and 66 in. wide in a deluxe GS model with five-speed manual transmission (shown here). Base model with four-speed transmission is 65 in. wide. Price for the base model: under \$6000.



Super sub

It's the fastest submersible in its class, says Perry Oceanographics (Riviera Beach, Fla.). Designed for oil-well work in treacherous currents off Brazil's coast, the PC1803 maneuvers at four knots. Four crew members can work at depths down to 984 ft.

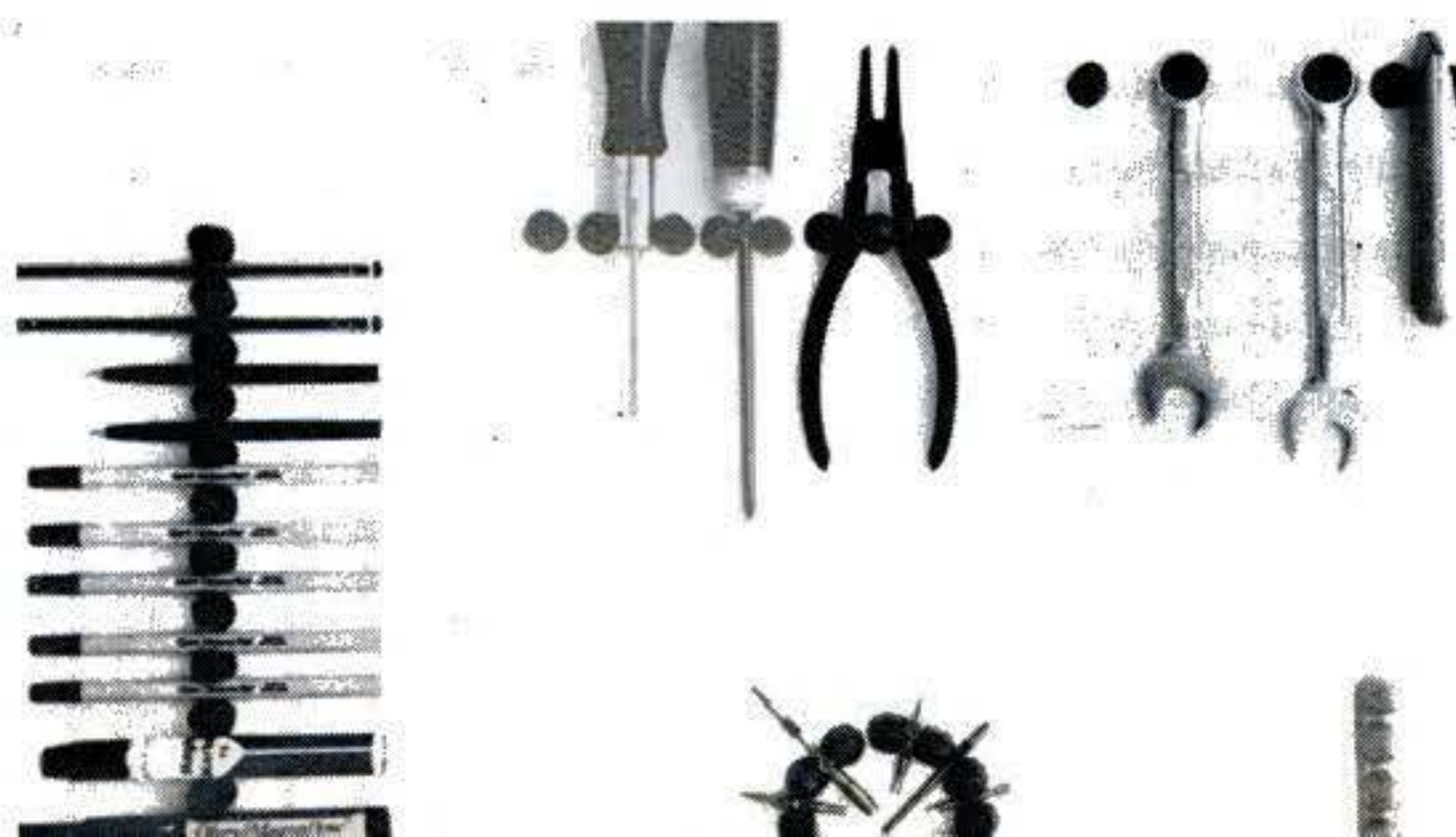


Twin turbos

The seven-place Hustler has a turboprop engine in the nose and a standby turboprop jet engine in the tail. Developed by Jet Industries of Van Nuys, Calif., the new plane's STOL characteristics enable it to take off or land in less than 670 ft.

Storage blobs

Can't find a place for such items as screwdrivers, pens, and keys? Londoner Oliver Hood won a design prize for his prototype "blob" storage system. Plastic-foam blobs of varying hardnesses secure items. C/O Messrs. Dunlop, 10-12 King St., London SW1Y 6RA, England.



Fold-up chair

Relax anywhere in a full-size deck chair that folds into a 25-in. carrying bag. The chair, which adjusts to eight positions, has an umbrella and storage pocket. It's eight lbs. "The Chair," by Jab Industries (352 Park Ave. S., N.Y., N.Y. 10010), is about \$40 in stores.



What's New IN PHOTOGRAPHY

By E.H. ORTNER



Total lens

Wide angle, tele, macro—the new Tamron 35-80mm f/2.8-3.5 macro/zoom is called the "total" lens by its distributor, BMC (Box 1102, Woodside, N.Y. 11377). In macro mode, it produces a 1:2 image-object ratio—half life size. It weighs 18½ oz., is 3⅓ in. long, sells for \$440.

Fast-film pocket cameras

There's a new line of Kodak 110 (pocket) cameras, designed to take the versatile 400-speed color-negative films introduced by Fuji and Kodak last year [PS, July '77]. Three of the models, including the Ektra 2 (left) and the Tele-Ektra 2 (inset), feature a protective cover that swings open and locks to form a handle. Both cameras have a 22mm f/5.6 three-element lens; the Tele-Ektra, in addition, has a 44mm f/5.6 lens for tele use. Exposure is controlled by shutter speeds—1/60 to 1/500—determined by film, flash, and a two-position user setting. Ektra 2 is \$31.95; Tele-Ektra 2, \$44.95.

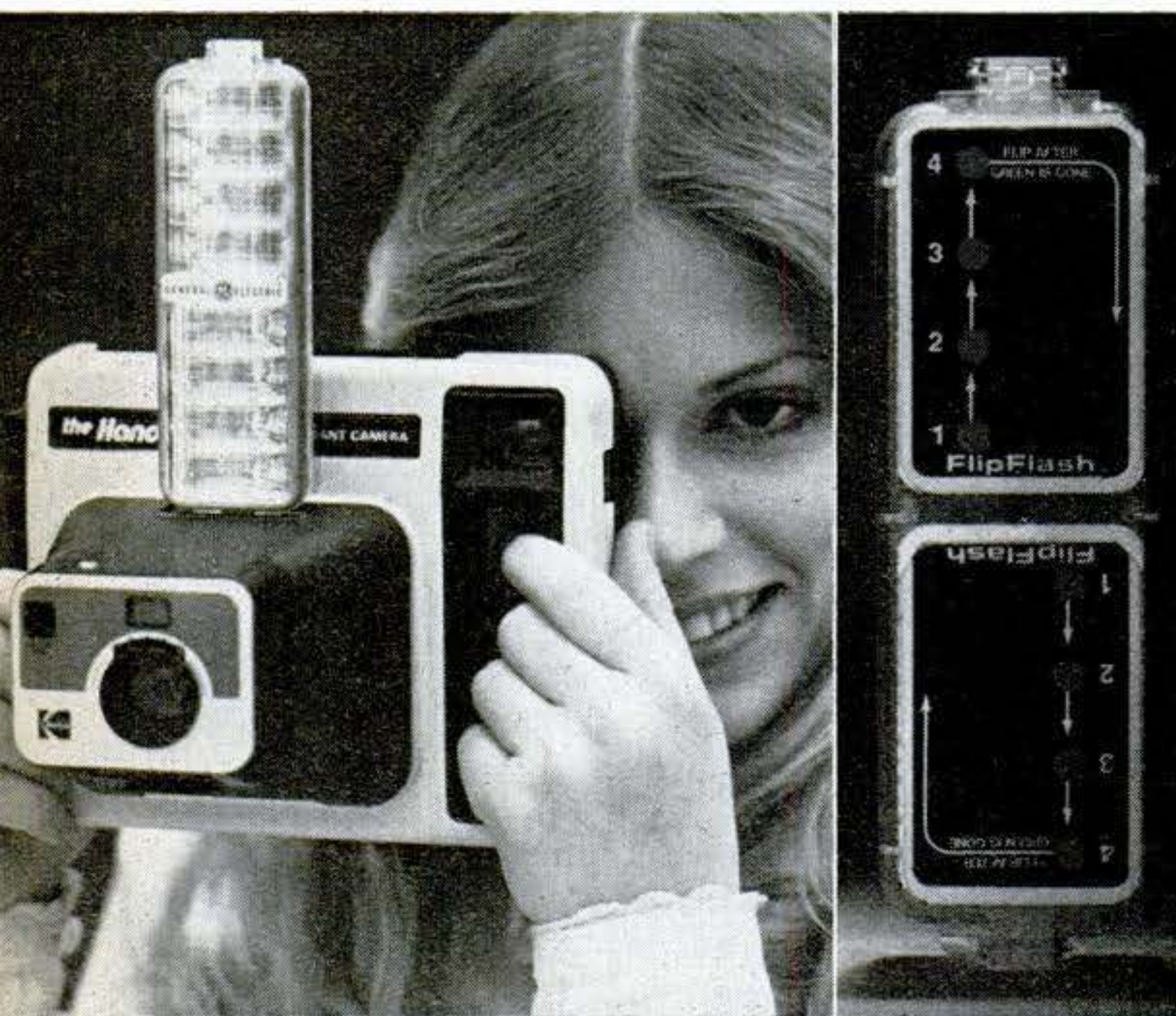


Tripod leveler

All three tripod legs extend to exactly the same length if you use a measuring tape, and Pace Photo Products (2204 Morris Ave., Union, N.J. 07083) has one just for that job. The Leveling Tape is a clear, self-adhesive vinyl with inch markings. Three 20-in. strips are \$1.95.

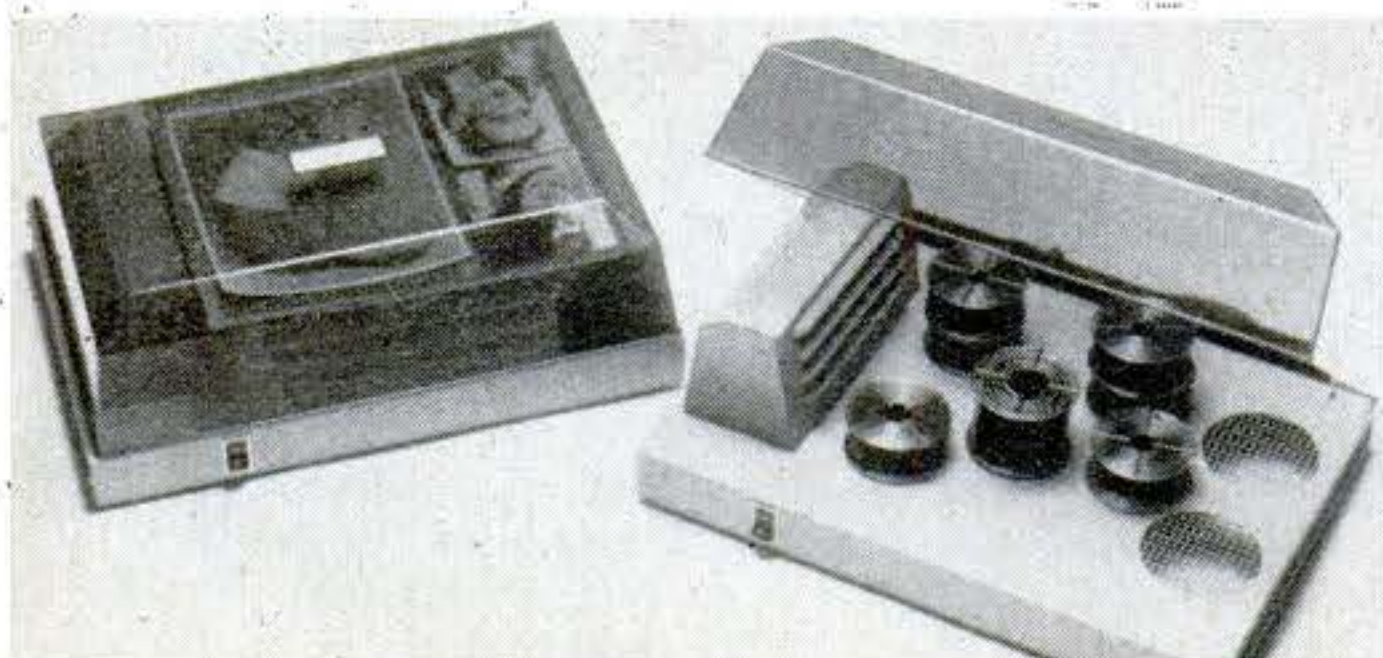
Horizontal array for FlipFlash

A new version of the FlipFlash will be appearing in stores this summer: FlipFlash II. You'll spot it because the bulbs are arrayed horizontally (instead of vertically) in white (instead of chrome) reflectors. The new bulbs generate 50 percent more light than the old ones, claims General Electric, and a molded Fresnel-patterned cover evens the illumination, preventing hot spots. Light-distribution ratio, center to side, is 1.3:1 against the previous 2:1. A "go dot" system on the back shows how many flashes you have left and which bulb will fire next.



Full-feature compact SLR

Now Konica has a lightweight full-feature compact SLR, too, plus a matching autowinder. The new Autoreflex T-4 weighs only 26.1 oz. with 50mm f/1.7 lens. The automatic-exposure system is the shutter-priority type (you pick the shutter speed; the camera selects the lens opening). The vertically moving focal-plane shutter offers speeds of one to 1/1000 sec. A special switch makes possible precise multiple exposures. The 10.5-oz. autowinder, powered by six AA cells, can transport film at a rate of 1.6 frames per sec. The T-4 with 50mm f/1.7 lens lists for \$415. The autowinder is \$130.



Dual-use dryer

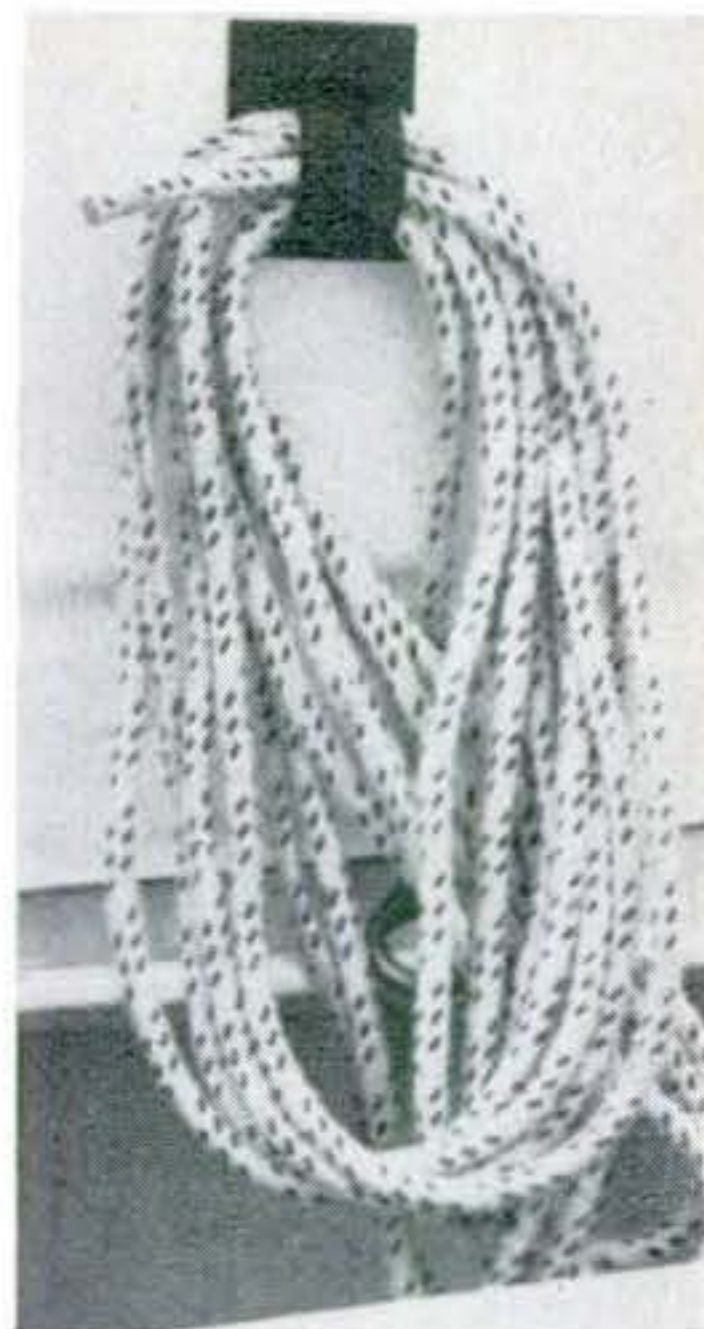
Filtered, thermostatically controlled warm air blows over prints (resin-coated) or film for fast drying in the APD dryer. It takes four 11-by-14 or 16 5-by-7 prints (in a removable rack) or 12 35mm reels. It's \$75 from Spiratone, 135-06 Northern Blvd., Flushing, N.Y. 11354.

What's New IN BOATING

BY SUSAN RENNER-SMITH

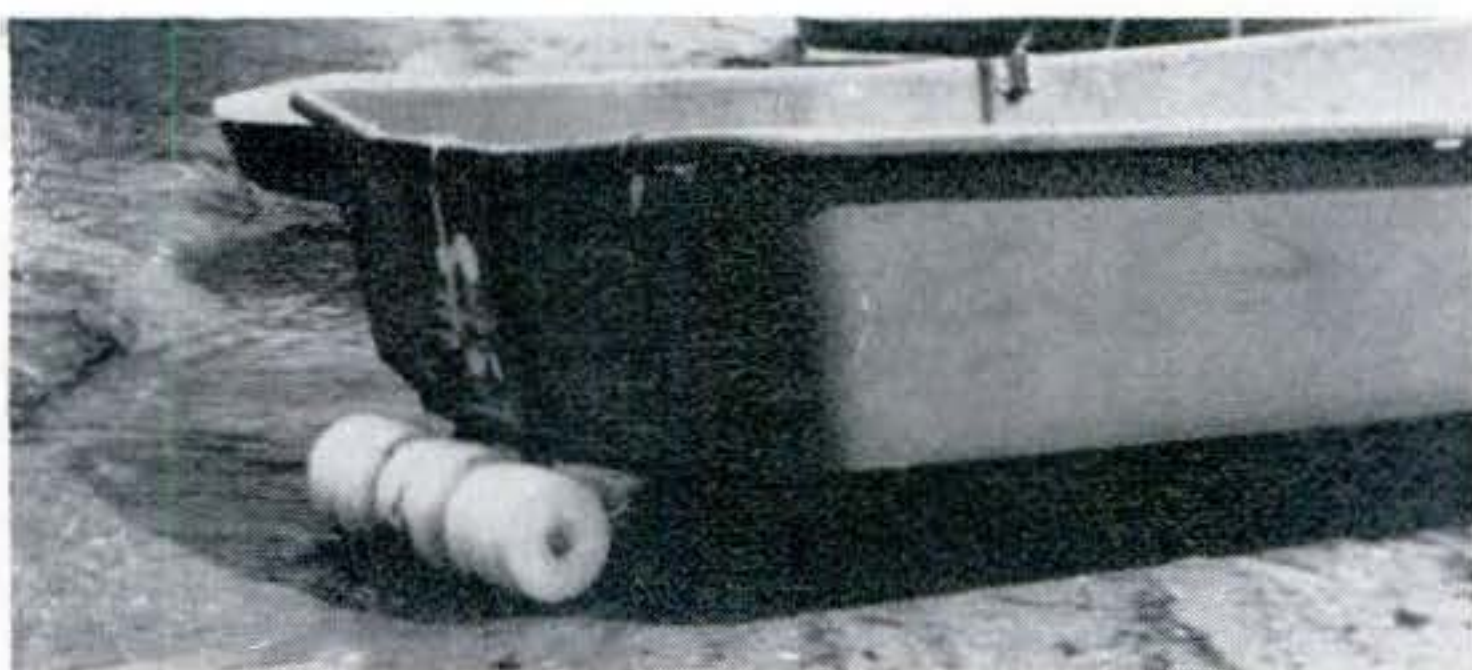
Fire fighter

Fire in your engine box? A heat-sensing coil in the Fiquench system automatically triggers a Halon 1301 extinguisher. There's also a manual discharge switch. The system protects up to 150 cu. ft. of engine space. Fike Corp., 704 S. 10th St., Blue Springs, Mo. 64015. \$290.



Boat roller

Wheeled dollies sink in sand, but not the Roller-eze. With it clipped to the stern, one person can easily tug a boat over sandy or rocky beaches, says Emeic, Box 71, Suncook, N.H. 03275. The 18-ft.-long, removable roller can support a 12-ft. boat. It's \$32.50 ppd.

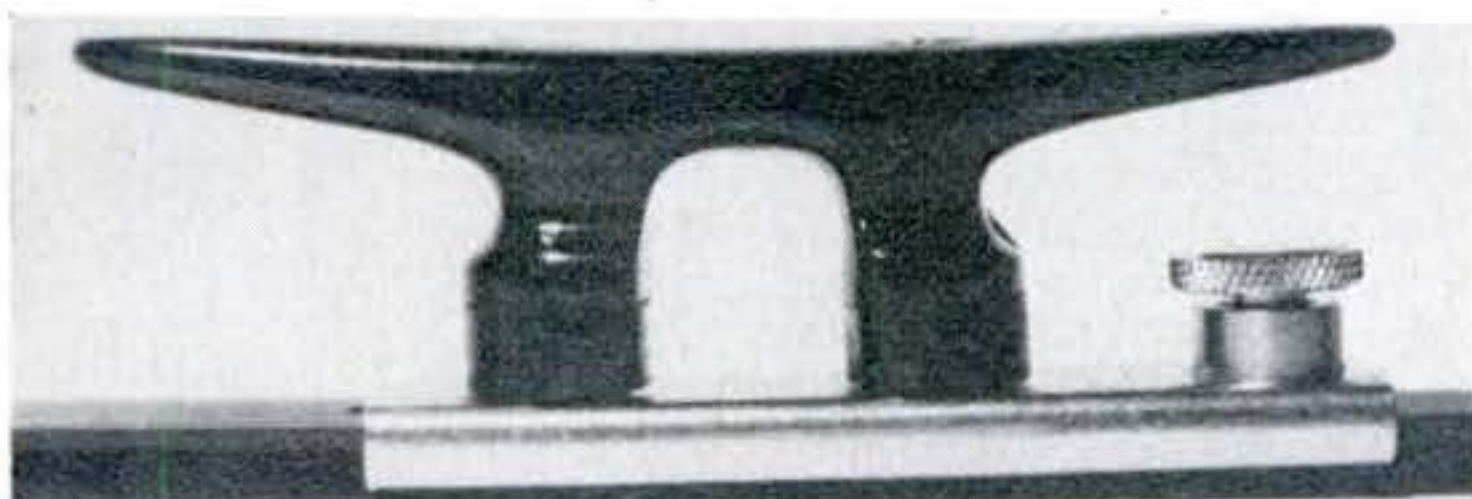


Handy holder

Clear the decks! The Snapper stores lines neatly just where you need them. Its barbed catch locks line in; a quick-release lever easily frees it. The nylon line holder epoxies to most boat surfaces, costs \$3.75. United Yachting, 23230 Tireman Ave., Dearborn Hts., Mich.

Movable cleat

Need a cleat just where you don't have one? No problem—release the thumbscrew and scoot the Midship Cleat along the track. Use the movable cleat with a 1-in. or 1 1/4-in. T-track. Price: \$19-\$22 from Nautical Engineering, Box 486, Plymouth, Mich. 48170.



Ratchet winch

This two-speed winch gives your back a break. Like a normal winch, cranking clockwise engages high gear for speedy tacking. Going counterclockwise triggers a ratchet action for extra power. M. S. Gibb Ltd., Warsash, Southampton SO3 6ZG, England.



Adjustable cord

Bind anything from oars (above) to sails with Super Cinch-It. Stretch cord adjusts from three in. to six ft., depending on where you hook its notched nylon "tooth." Finger loops at each end make tie-downs safe. I.S.I. Mfg., 3116 Monticello, Dallas, Tex. \$2 each.

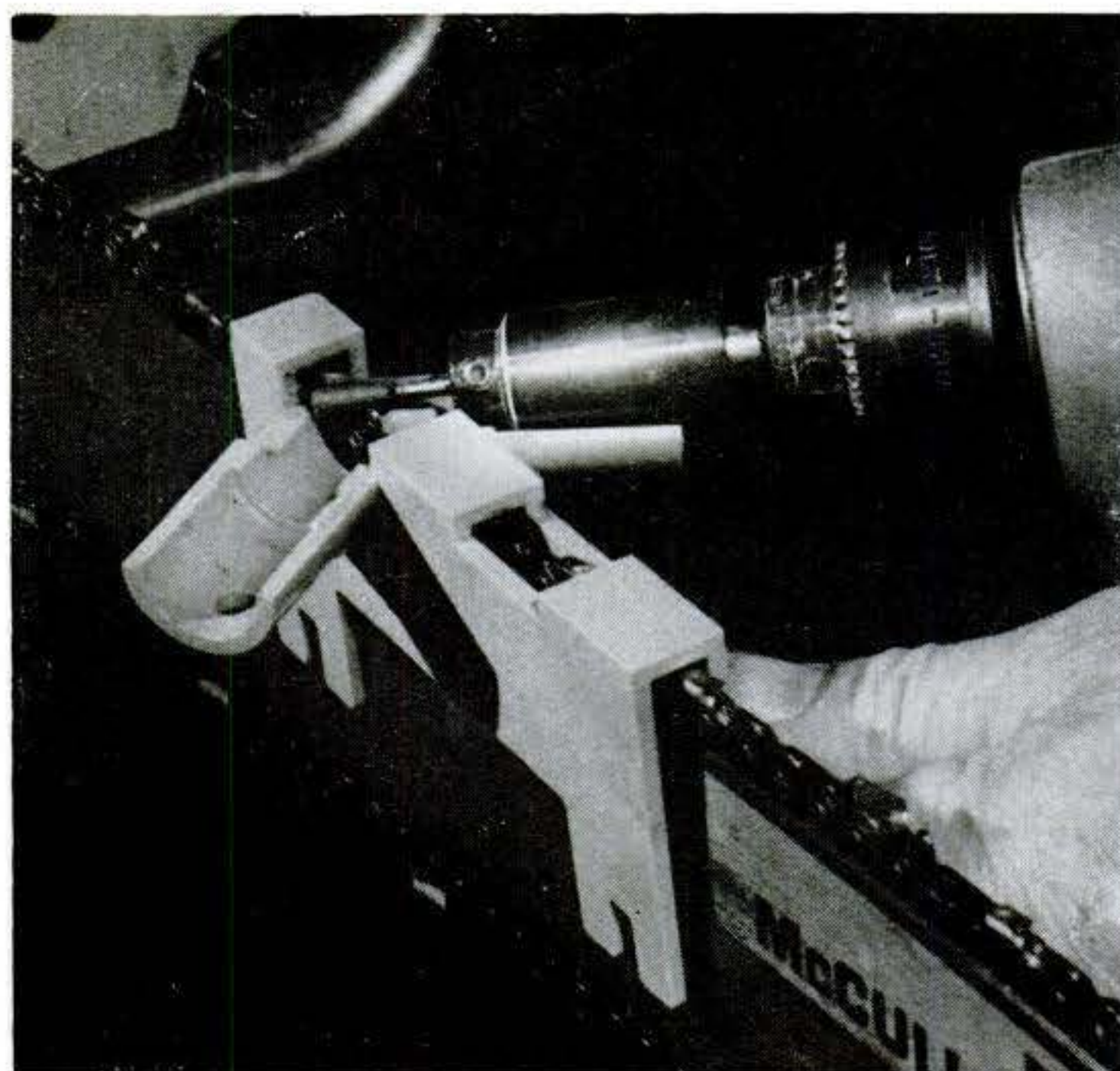
Paddle mates

This versatile craft is either canoe or kayak, depending on how you finish the basic fiberglass hull. A low center of gravity makes the 10 1/2-ft. hybrid a stable, easily handled boat, says Aladdin Prod., Box 231, Wiscasset, Me. 04578. Hull plus instructions: \$119.



What's New IN TOOLS

BY R. L. STEPLER



Torch

The Jet Torch II has full braze-welding capabilities with low-cost propane, says Bernzomatic. Its \$19.95 price tag includes pressure-regulated burner head, spark lighter, two brazing rods, and a 14.1-oz. cylinder of propane.

Unsinkable axe

Axe overboard? Don't worry; this one floats. Pour 30 oz. of sand into Flot-Axe's hollow handle, and it's ready for use. The 12-oz. tool is cast of lightweight heat-hardened alloys. It's \$24.95 from Lilia, Inc., Box 21-4333, Sacramento, Calif. 95821.

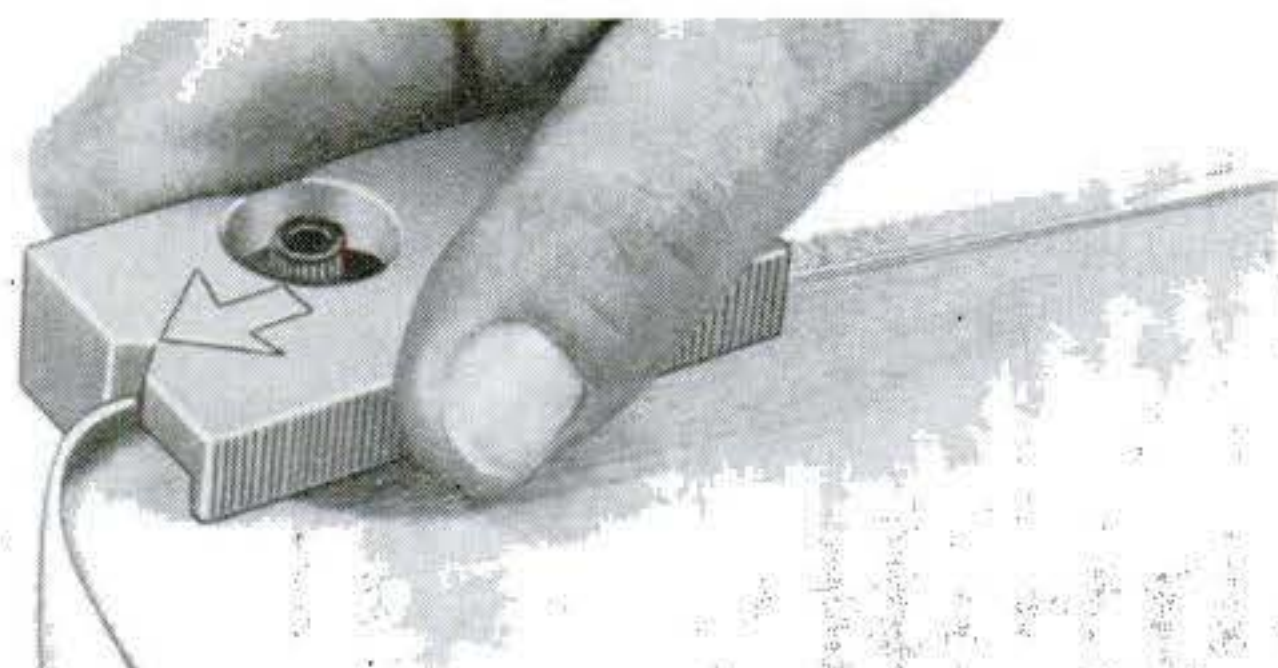


Drill-powered chainsaw sharpener

Your quarter-inch electric drill supplies the muscle for this chainsaw sharpening device. The Pro Sharpener features a miniature grinding wheel that the manufacturer claims produces a ground edge on the saw tooth—sharper than a filed edge. The grinding wheels come in five sizes from $\frac{1}{8}$ inch to $\frac{1}{4}$ inch, to fit all chainsaws. A built-in gauge measures the proper guide tooth height. With three grinding wheels (you specify the size), the unit costs \$14.90 from Pro Sharp Corp., Box 11378, Newington, Conn. 06111.

Sanding block

They're flexible, washable, and reusable, says Coastal (Trumbull, Conn. 06611). Sanding Sponges can be used wet or dry, and their flexible cores let them follow irregular surfaces. They're offered in medium/fine or medium/coarse, with abrasive on all sides. Price: \$1.20.



Laminate trimmer

This edge trimmer for laminates and veneer is said to cut flush with the surface without marring it. A steel cutting disk aligned with the tool's smooth underside slices off protruding material until it's level with adjacent surface. CeKa Works Ltd., Pwllheli, Gwynedd, North Wales, U.K.

Handsaw

Horizontal cuts should be easier with Disston's Twist-n-Lock saw because the tool's removable blade can be rotated to any position. Blades are available for cutting wood, metal, and wall-board.



Digital tach

GrahamTach's digital read-out shows rpm or fpm, updated every second. The cast-aluminum, hand-held device has a range to 19,999 rpm, uses four AA batteries. It's \$169 from Graham Transmissions, Box 160, Menomonee Falls, Wis. 53051.

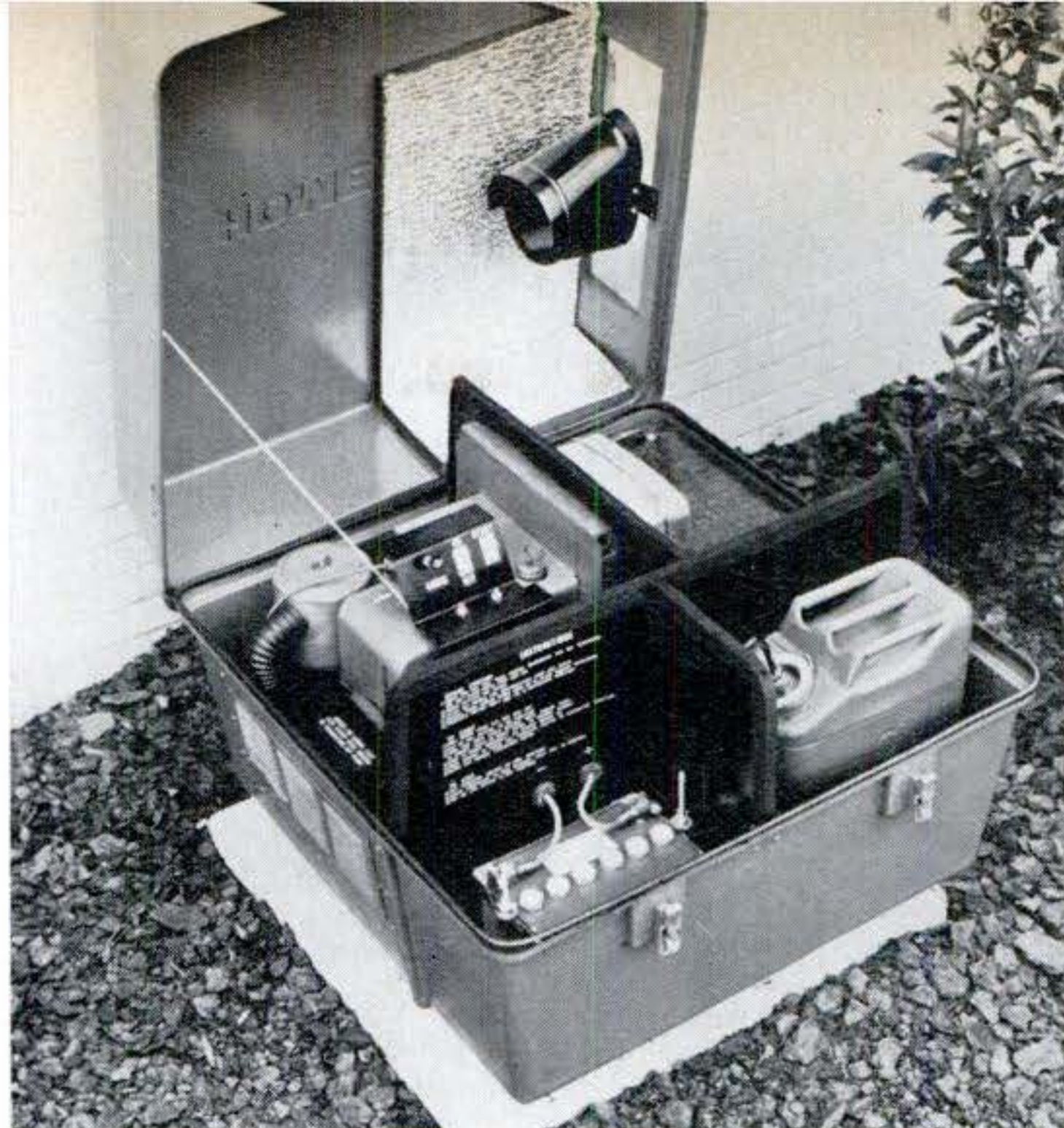
What's New IN HOME IMPROVEMENT

BY R. L. STEPLER



Water detector

Battery-operated Flood Guard sounds the alarm when one of its sensors detects water. One unit offers protection against failed sump pumps, backed-up drains, leaking basement walls, and overflowing toilets. It's \$14.95 from Symtec, Box 462, Farmington, Mich. 48024.



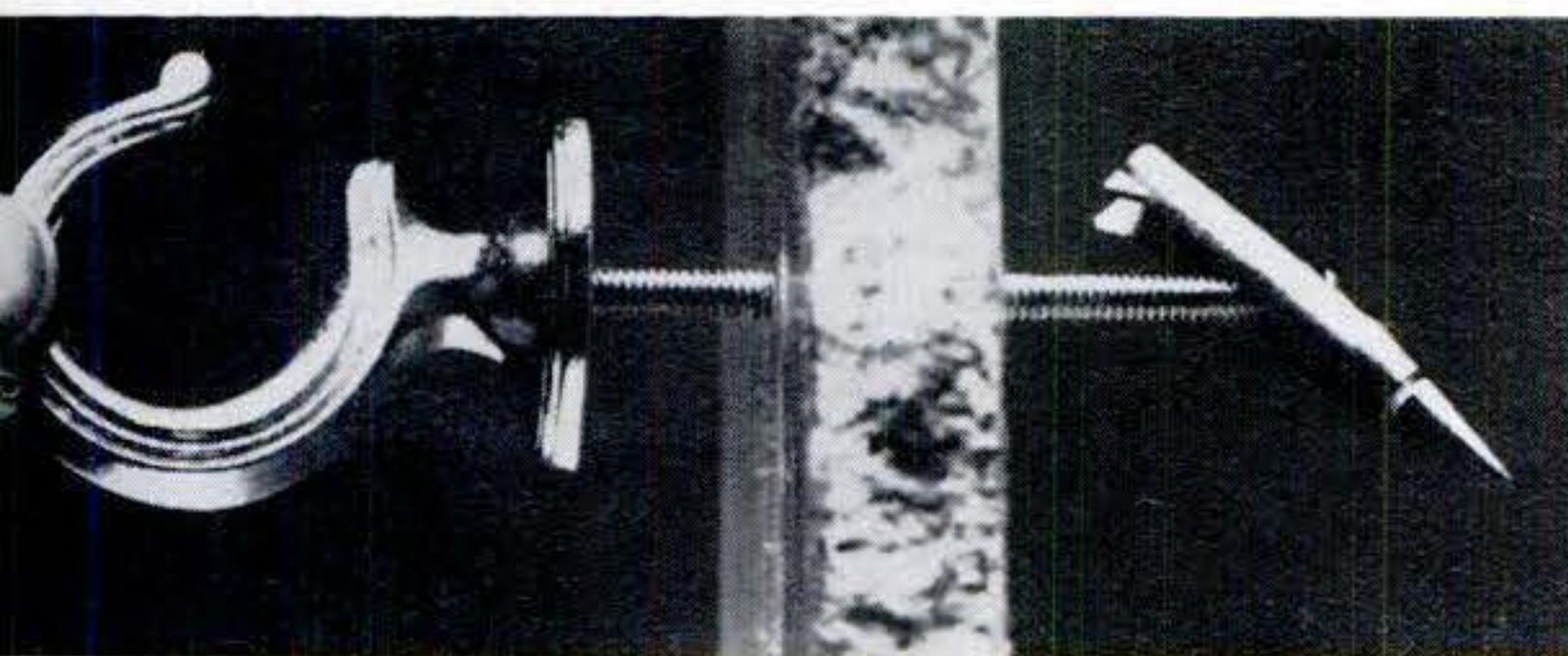
Standby generator

A lockable, weatherproof ABS enclosure holds Homelite's model HSB50-1 emergency generator. The self-contained unit puts out 5000 watts at 60 Hz, 120/240 volts AC. That's enough, says Homelite, to power your heating system, water pump, refrigerator, a few lights, and other essential appliances in a blackout. The rig features a 10-hp engine, five-gallon fuel tank (enough for eight hours of operation), electric start, automatic oil-level monitor, and emergency rope start. Cost: about \$2000, installed. Homelite, Box 7047, Charlotte, N.C. 28217.



Door insulation

Semirigid, vinyl-backed fiberglass panels easily clip in place to insulate steel garage doors. A package of eight covers single-car doors up to nine feet wide. Stanley Door Systems, 2400 E. Lincoln, Birmingham, Mich. 48012, makes it.



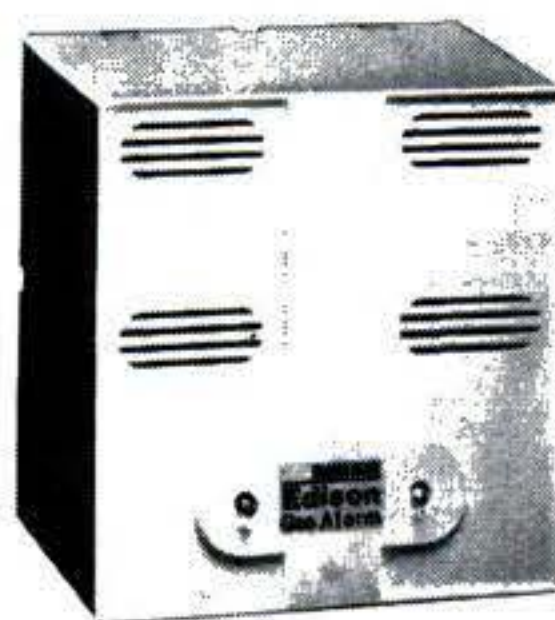
Ceiling hook

No drilling for toggles or mollies with Hollowall hooks: A toggle-bullet penetrates wallboard with the tap of a hammer, then flips to form a T. Turning the hook screws the bolt into the bullet, securing it. Gries Reproducer Co., 400 Beechwood Ave., New Rochelle, N.Y. 10802.



Sauna stove

Wood fires the Aito sauna stove. Lined with mineral wool and firebrick, the Finnish-made stove contains heat-retaining periodotite stones and is said to provide two days of sauna bathing on one firing of wood. Solar Sauna (Box 466, Hollis, N.H. 03049) sells it.



Gas alarm

Leaking natural gas, LP, or propane causes McGraw-Edison's gas detector to sound a piercing alarm. Green and yellow LED's indicate unit is powered and operational. Price of the solid-state, plug-in device: \$49.95. McGraw-Edison, 1801 N. Stadium, Columbia, Mo. 65201.

Oil furnace

Blueray's blue flame means higher efficiency and zero smoke emissions, claims the maker (Blueray, 375 N. Broadway, Jericho, N.Y. 11753). ERDA tests show an average efficiency of 83.4 percent for the furnace, which reburns the waste products of fuel-oil combustion.



What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



Super CB

GE calls this the SSB Superbase, but you might think of it as the most flexible single-sideband CB rig made. There's a button and display for just about every operational mode—including dual antennas. GE's 3-5875 base station is \$469.95.



Preprogrammed home computer

Pop in a preprogrammed cartridge and the VideoBrain is ready to compute your finances; do cash management, real-estate analysis, and stock evaluation; or tutor your kids in math. Connected to your TV set, the home computer produces color images and words for each of the 12 programs presently available. A keyboard and two paddle levers allow you to control and respond to programs being run. The computer runs from instructions supplied by the individual cartridges. The VideoBrain is \$500 from Umtech, 150 S. Wolfe Rd., Sunnyvale, Calif. 94086.



Money watcher

Enter the area code of your next phone call on the Tele-Coster I keyboard and you'll save money: A digital display shows time and phone charges, warning when the next unit charge is coming up. It's made by UVC Corp., 66 Commack Rd., Commack, N.Y. \$99.95.

Snap-on cover

If you have speaker cables, extensions, or even intercom lines that run above the floor line, place them in this Flexiduct Cord-Cover. It protects both cable and pedestrians. It's made by Winders & Geist, 1821 Yolande, Lincoln, Neb. Price: \$7.95 for a six-foot length.

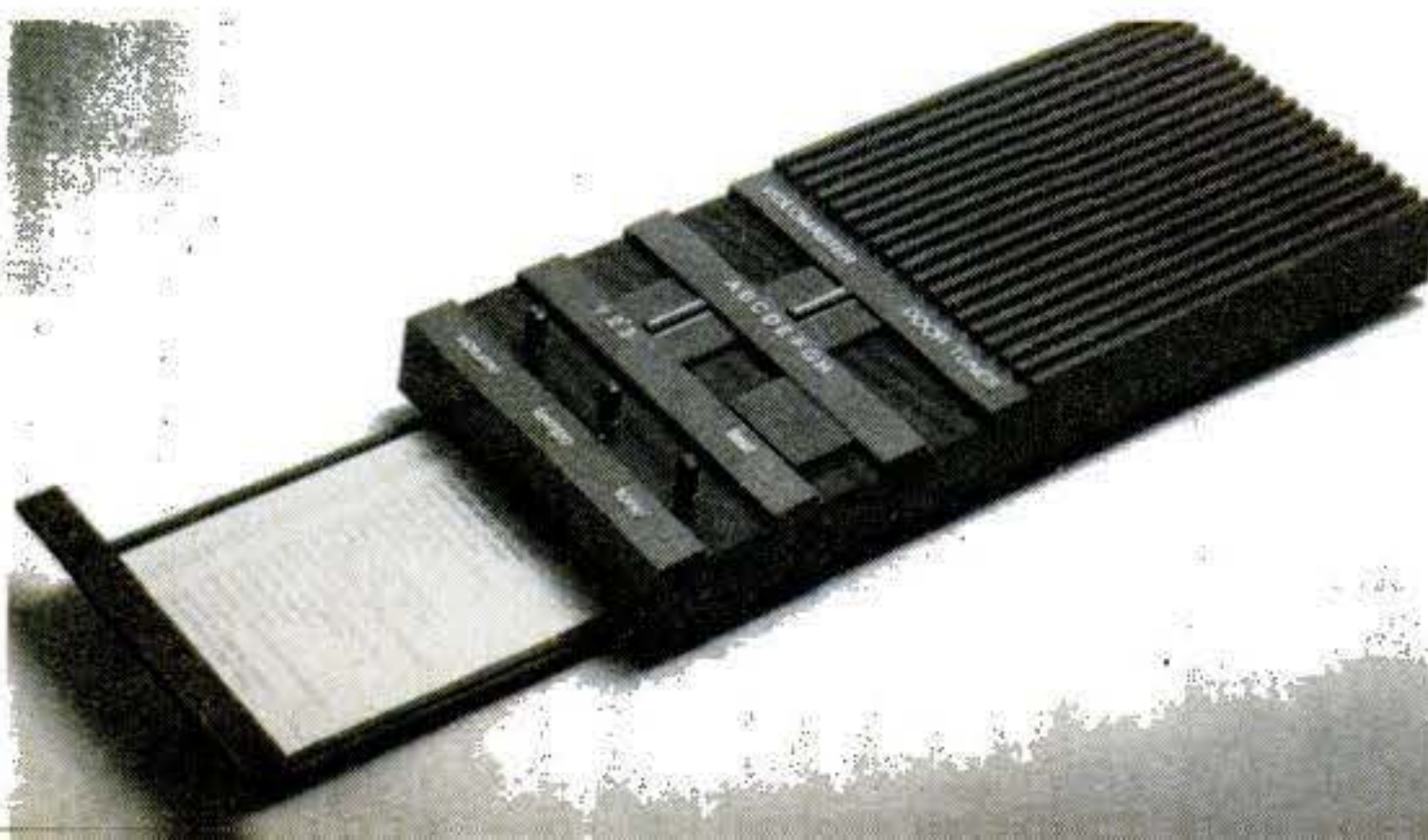


Musical doorbell

Hook the doorbell button to a Door Tunes unit and a visitor will be playing your song, or any one of the 24 selections available—from Mozart to Stars and Stripes—at the flip of a switch. It's \$49.95. From Internet, 8383 Wilshire Blvd., Beverly Hills, Calif. 90211.

Highest power

If you want a receiver with a little power, buy anything. If you want one with the most power available, however, turn on this Pioneer SX-1980. You'll have 270 watts per channel available when you need it. DC amp is relay-protected against overload. It's \$1250.



What's New FOR YOUR CAR

BY RICH CEPPOS



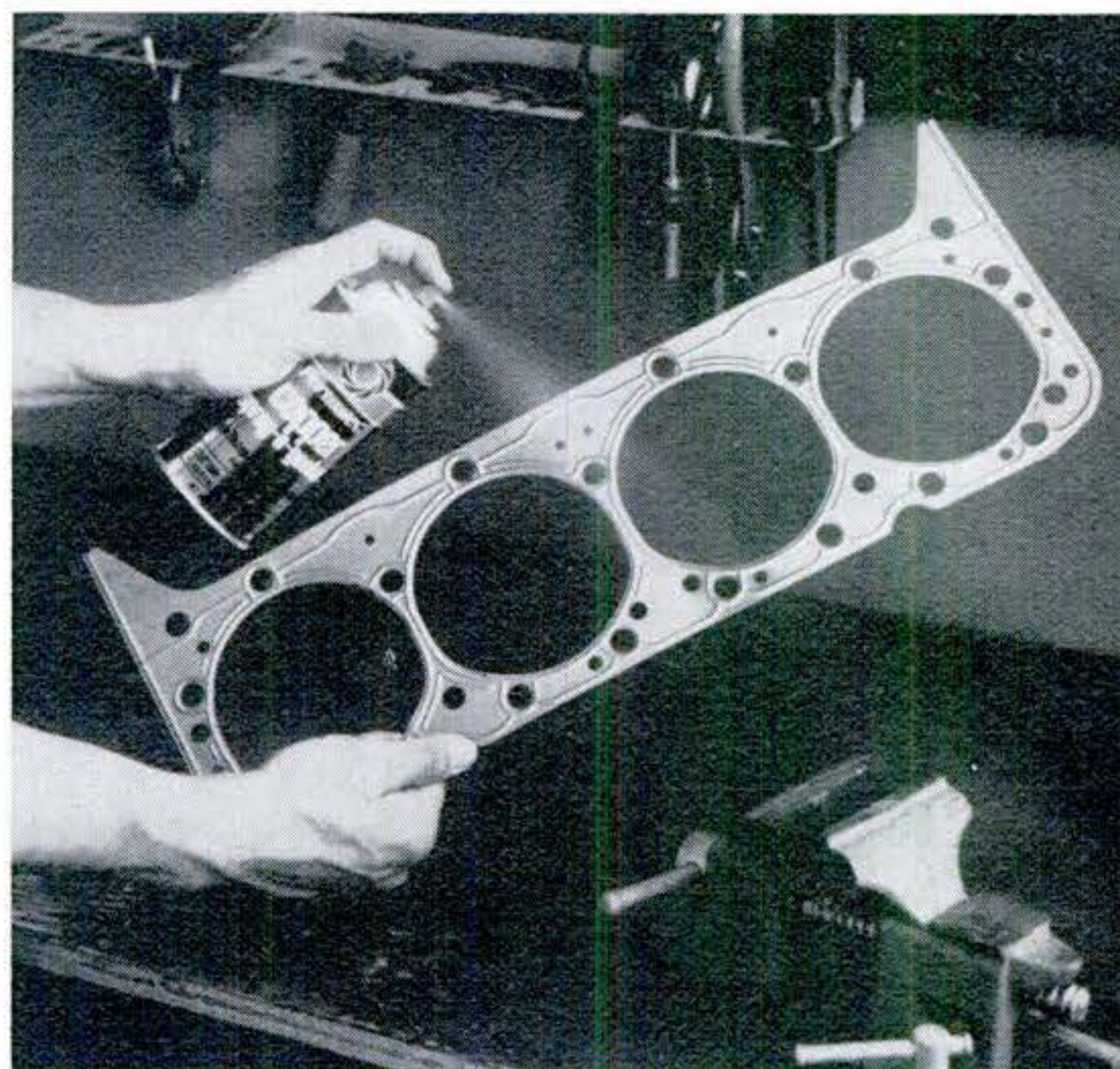
Van roof

The sleek Vista-Max fiberglass van roof provides added head room and can support 500 lbs. of cargo. Its Plexiglas skylight brightens any van's interior. It installs in a weekend, says Nunn Plastics Corp., 421 W. Main St., Lexington, Ill. 62753. Price: \$795.



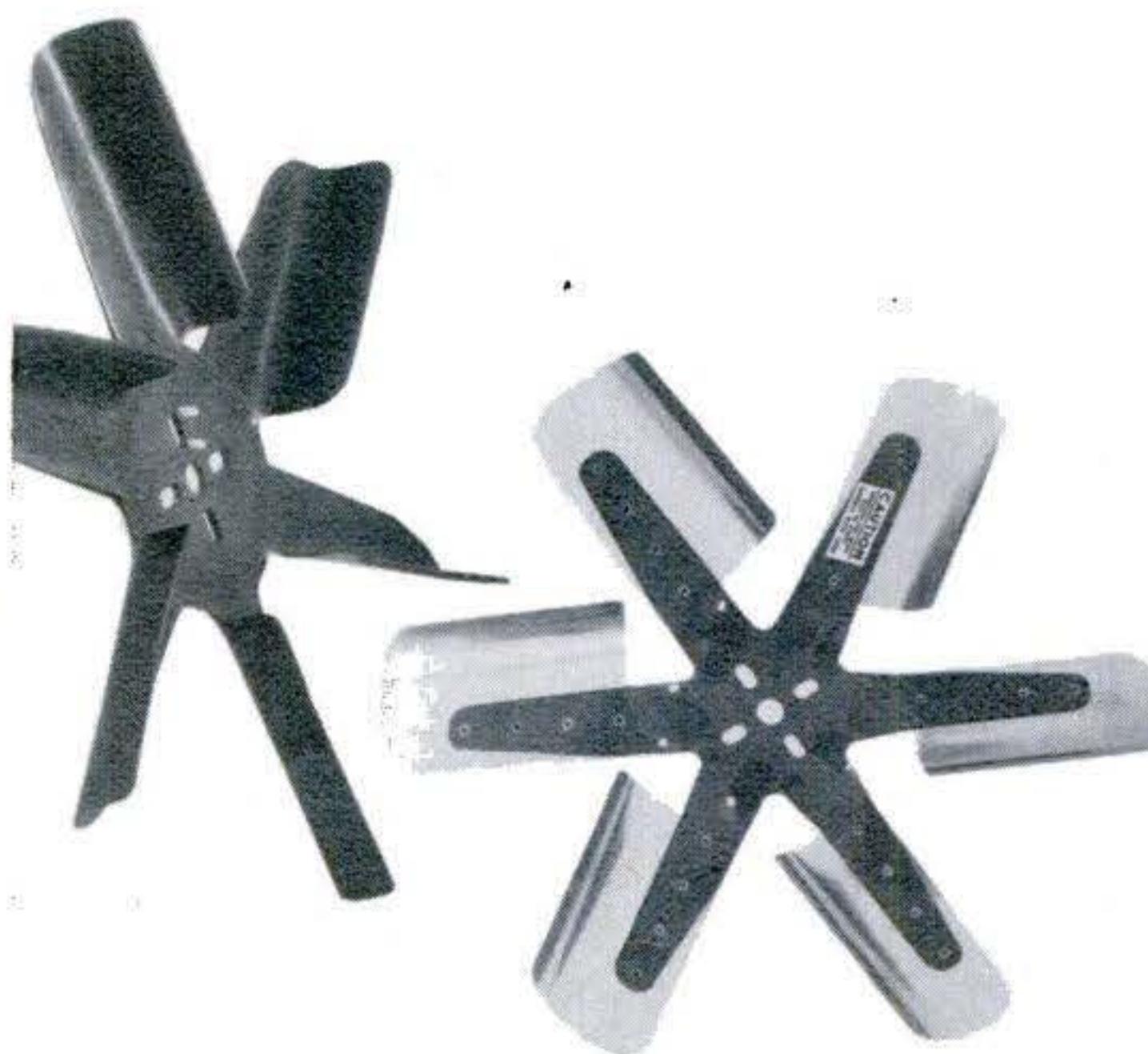
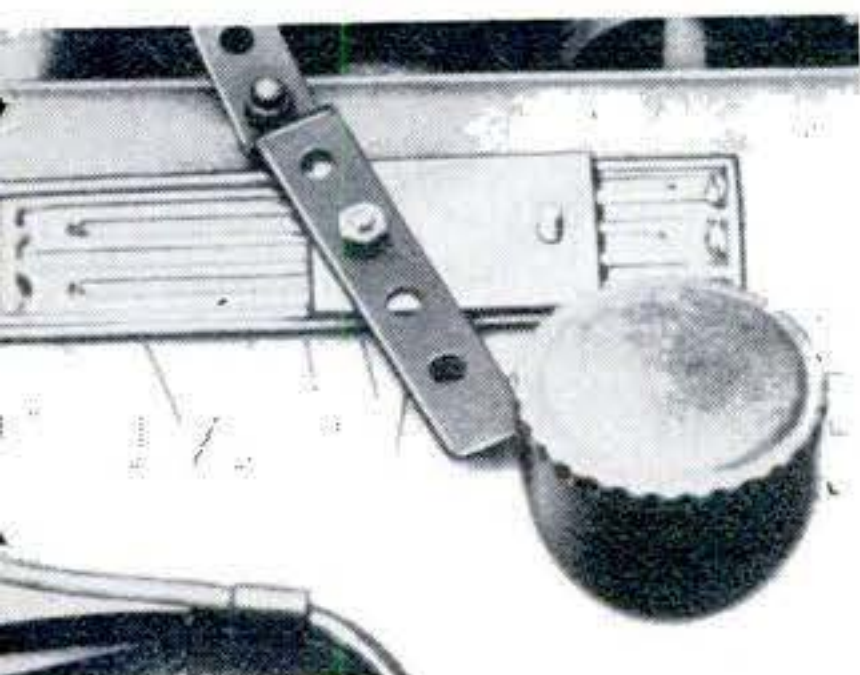
RV tire

When the going gets tough, the Scat Trac Mud Wamper gets going, says distributor J.C. Penney (1301 Ave. of the Americas, New York, N.Y. 10019). The high-flotation nylon-cord Wamper is designed specifically for swamp, mud, and clay. Prices start at under \$70.



Tire saver

When the piston in the Tiresaver valve-stem cap is below the cap's edge, your tire needs air. Available for all car and truck tires, they're \$5.75 for a set of four. International Marketing and Trading Corp., Suite 704, 1522 K St., N.W., Washington, D.C. 20005.



Gasket sealer

Copper Spray-A-Gasket is specially formulated to seal hard-surface, non-absorbent gaskets, says Woodhill Permatex (18731 Cranwood Parkway, Cleveland, Ohio 44128). It contains copper to help eliminate hot spots, improve heat transfer, and to fill minor irregularities.

RV fan

Flexible RV radiator fans perform more efficiently, says Valley Tow-Rite (1313 S. Stockton St., Lodi, Calif. 95240). The fans (fiberglass, \$18; stainless, \$30) draw the maximum volume of air at low speed when it's needed most. At high speed they flatten and use less power.

Washer warmer

Warm windshield-washer fluid minimizes icing in winter and eases bug cleanup in summer. The tiny heat exchanger clamps onto the radiator or engine. Price: \$12.50. Oliver Industries, Inc., 781 Whalley Ave., P.O. Box 3104, New Haven, Conn. 06515.

Pickup racks

When you're through hauling cargo, the side racks of the Sportsman's Bench pickup bed flip down for use as a bed or bench. Stephen Wood Products, Inc., 605 Huron, P.O. Box 669, Grayling, Mich. 49738. Price per pair: \$170 (6-ft. length) and \$200 (8-ft.).



Making instant movies

Here's what it's like to use the new Polaroid system

No skill is required, and—to a PS editor's surprise—it's the life of the party

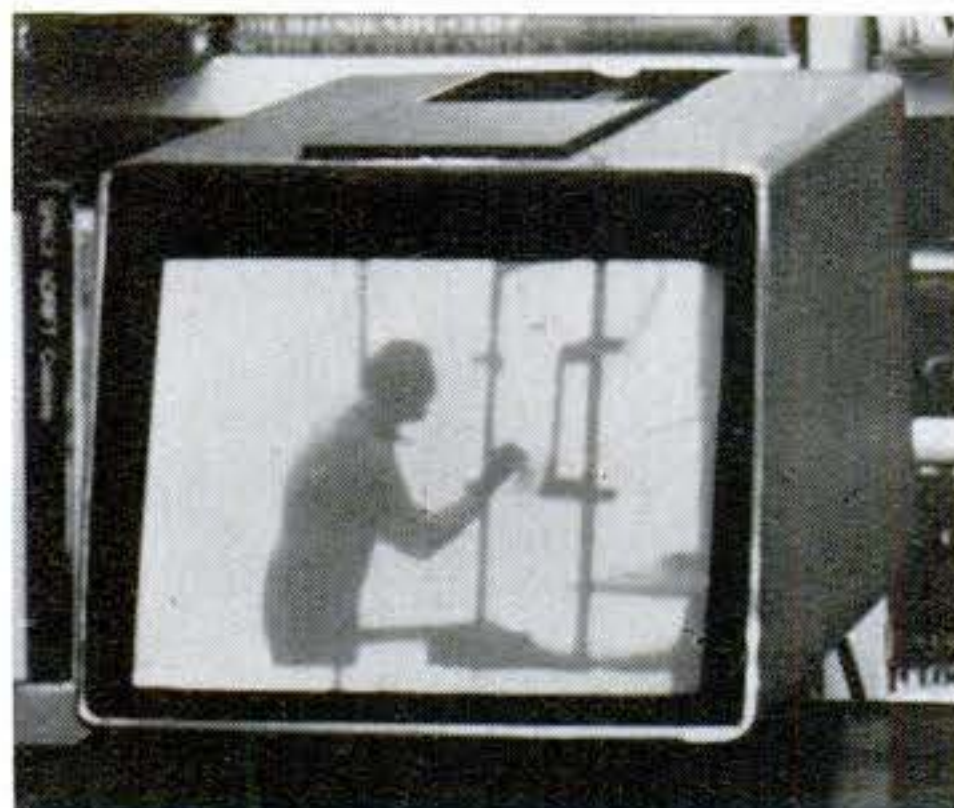
By EVERETT H. ORTNER

The hit of the last two parties in my home, and of Christmas dinner in the home of friends, was a treat no one had sampled before: instant movies. Almost before I'd finished shooting a Polavision cassette, a crowd would have gathered before the Polavision projector—or “player,” as the Polaroid people call it—waiting impatiently during the 90 seconds it takes for the film to be processed, the player to light up, and the show to go on. More, they stayed on to watch each cassette being rerun over and over. Buffet table, punch bowl, and bar were deserted while our guests watched in fascination the almost-instant replay of scenes they had just witnessed.

This newest miracle from Dr. Edwin H. Land, the inventor/board chairman of Polaroid Corp., involves two major components: the player, just mentioned, and a light, simple, automatic-exposure movie camera. But the true heart of the system is the cassette that holds the 38½ feet (and 2½ minutes) of super-8-format film [see “Inside Polaroid's Instant-Movie System,” PS, Aug. '77]. The film never leaves the cassette. It is exposed within the cassette in the camera. It is both processed (in a reagent chamber in the cassette) and played when the cassette is inserted in the player.

The film is like no other on the market. There are no dye images

through which light is projected. Instead, images are trapped through microscopic stripes of color imprinted on the back of a polyester film base. These stripes—red, green, and blue, 4500 per inch—break up the incoming light into the same three color components. The light exposes a series of silver-halide layers on the film. In processing, the images formed in these layers are changed through chemical magic into positive silver images. And finally, on projection, these silver images distribute the light back through the



Player's 12-inch (diagonal) screen is about the size of a small TV.

colored stripes in the same pattern (and thus colors) created on exposure.

In image quality, Polavision is inferior in almost every way to regular super-8 film. But is it fair to judge this system by normal standards? Remember, Polavision attempts what no other system does: to deliver the show immediately. Anyway, let's get the bad things out of the way first:

- Close up, the screen image has an odd “pointilistic” appearance, as

if created by a French Impressionist painter—all pepper and salt, but, of course, in color.

- The picture is excessively contrasty. Where it is bright, it is very bright; where it is dark, the darkness overwhelms much of the detail.

- Disturbingly, there is a very limited angle of view—about 45 degrees, I would estimate. Move out of that angle to either side—or even stand up with the player down low—and the picture dims and then, as you move increasingly off axis, disappears. Put the player close to a wide sofa, and sitters at either end will see a picture markedly inferior to the one seen by those in the middle.

Amazingly, however, despite all these seeming defects, sit five or six feet or farther away, and the picture looks surprisingly good. The dots pull together to form a very acceptable picture. Colors are bright and reasonably accurate. Skin tones are good. And friends and family are recorded live, for immediate laughter or admiration or whatever they bring out.

Another big plus: This is an easy system to master. The camera resembles an inexpensive automatic movie camera in simplicity. It is, literally, a load-and-shoot camera with a two-position focusing collar around the lens. You push it out for close-ups (six to 15 feet), in for distances over 15 feet. A 2:1 zoom (12.5-25 mm) provides modest wide-angle or telephoto shots.

The player requires only the insertion of a cassette. It automatically sees to the processing of a newly exposed cassette, then turns on the lamp and runs the film.

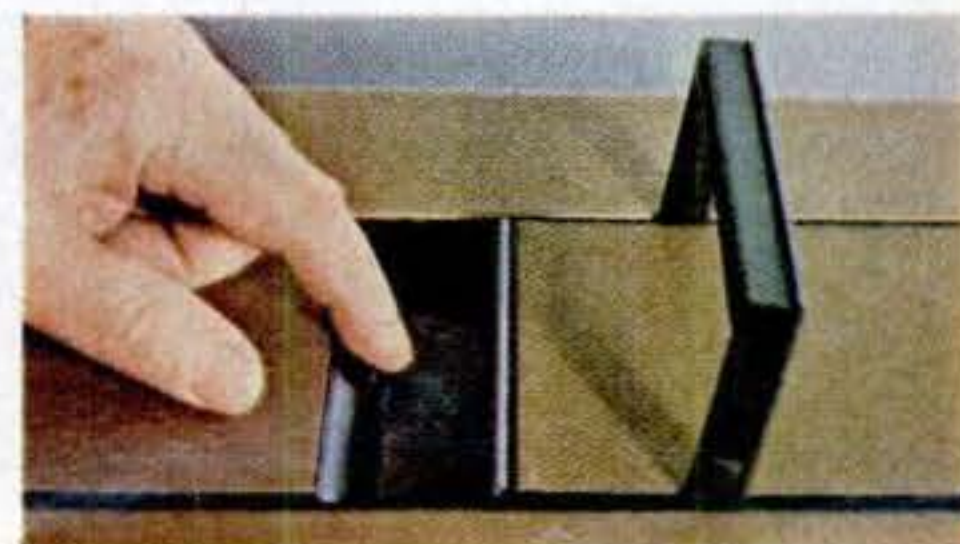
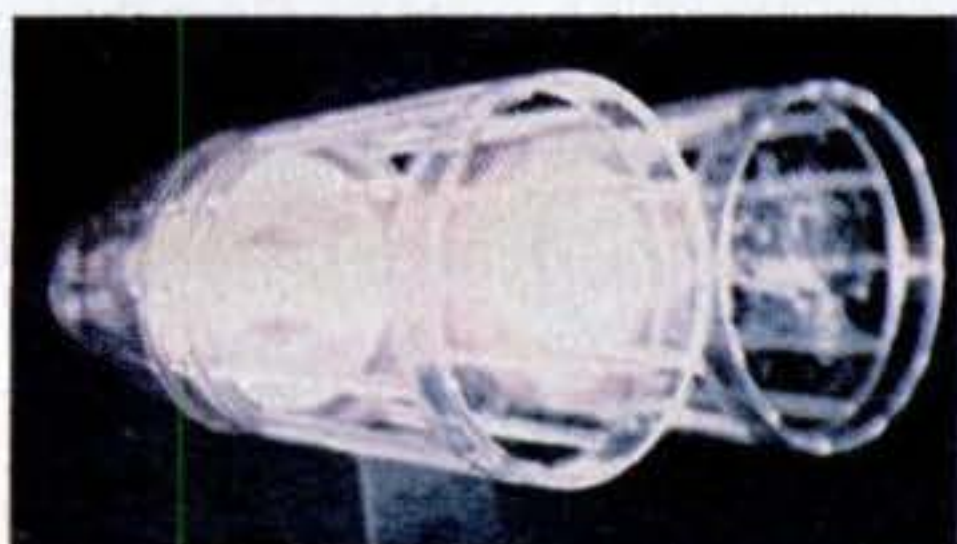
[Continued on page 184]



Polavision picture is grainy and contrasty close up, but surprisingly pleasant from a few feet away. PS staffers found skin tones to be realistic; even candles at the party buffet registered accurately.



Ready for the party: Polavision camera above carries two-beam Twi Light (\$42; shown separately below). The cunningly designed light doesn't get hot to touch, is effective to 10 ft. Player, a portable 24 lbs., starts automatically when cassette is inserted. Player's back opens for access to cord or lamp. Disk-shaped Instant Replay, being plugged in, stops cassette, winds it back 10-20 seconds.



Teletext/Viewdata

converts your TV set
into an instant information service

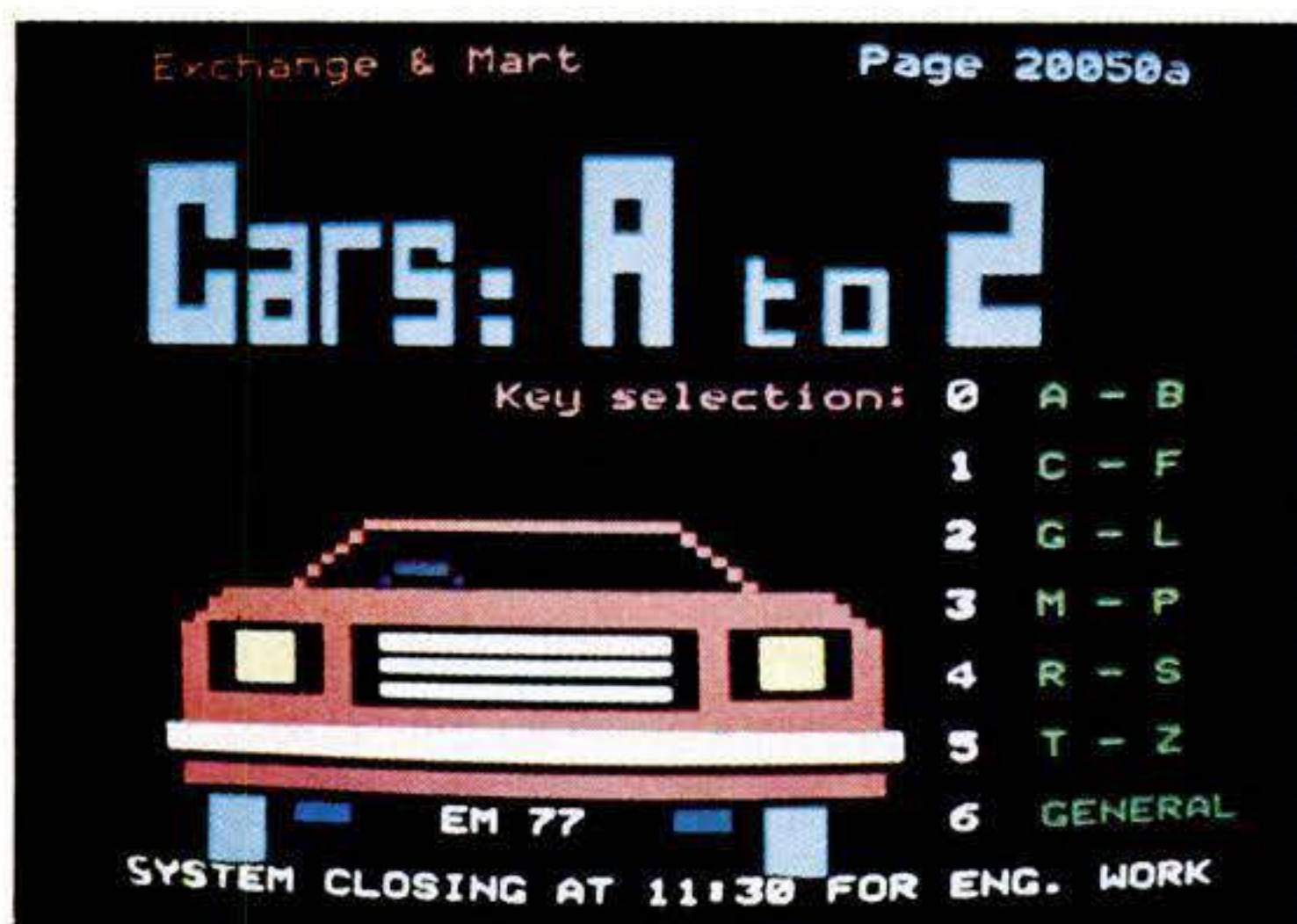
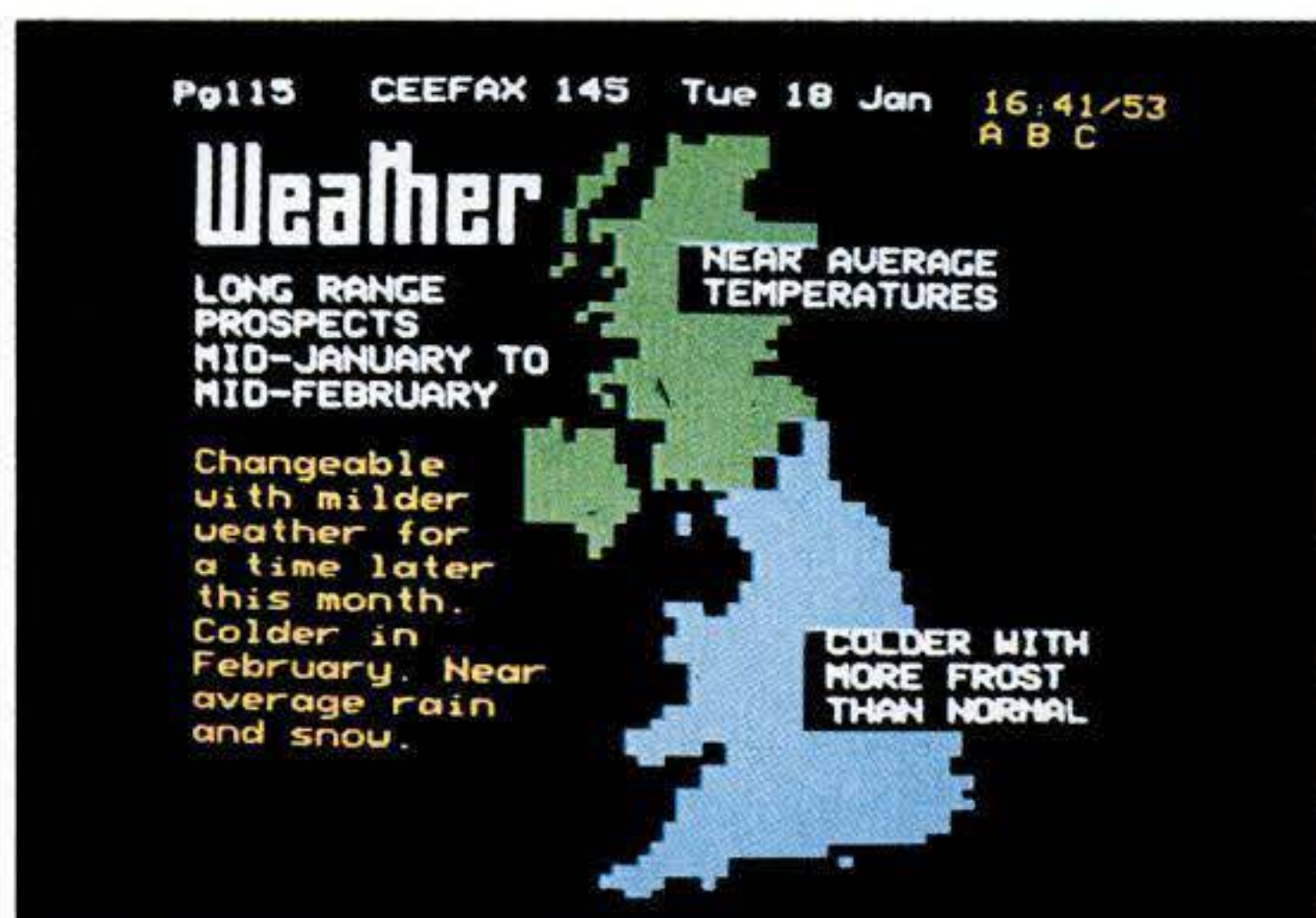
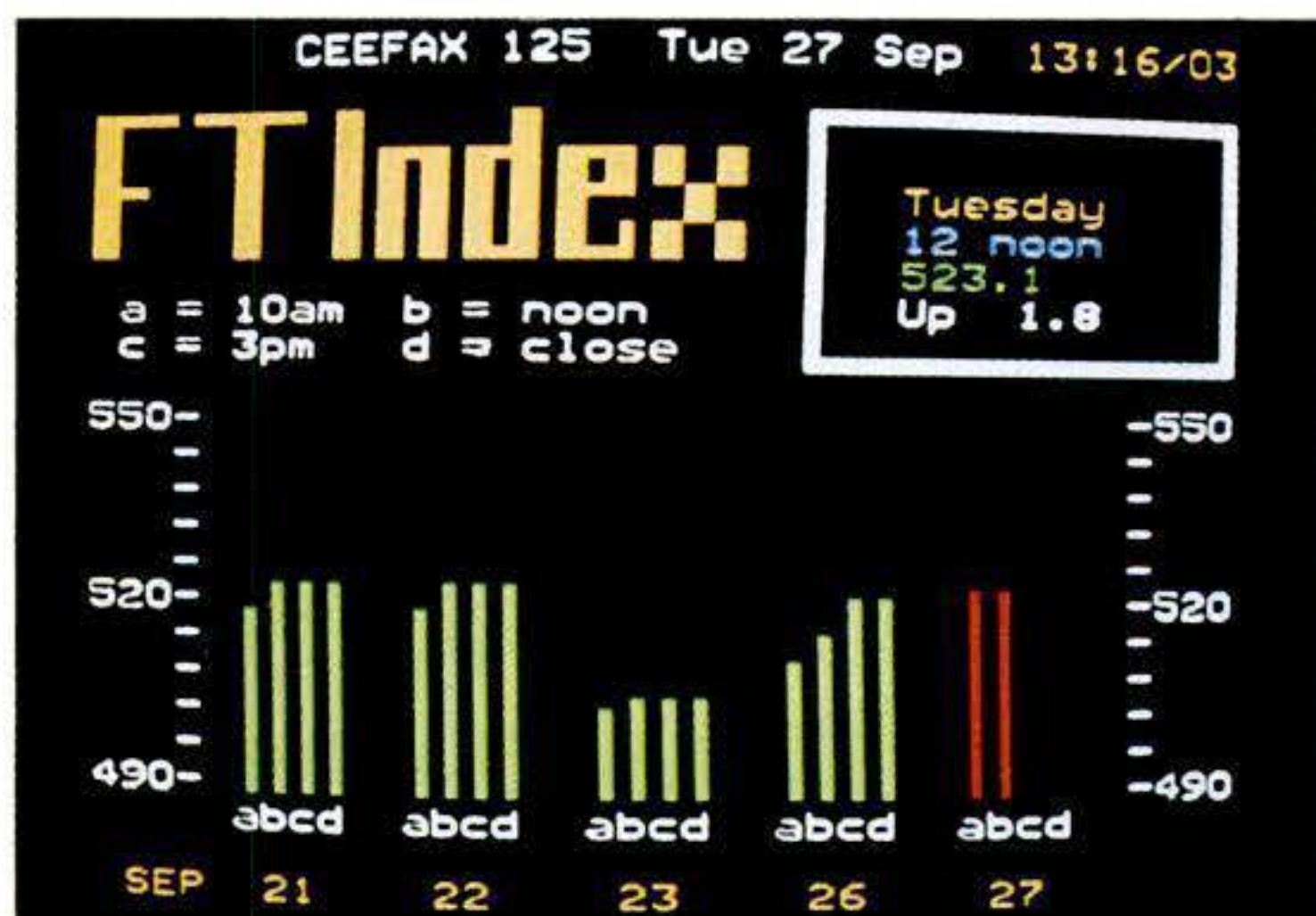
Used-car prices? Tomorrow's weather? Sports results? Just ask your TV

By DAVID SCOTT

LONDON, ENGLAND

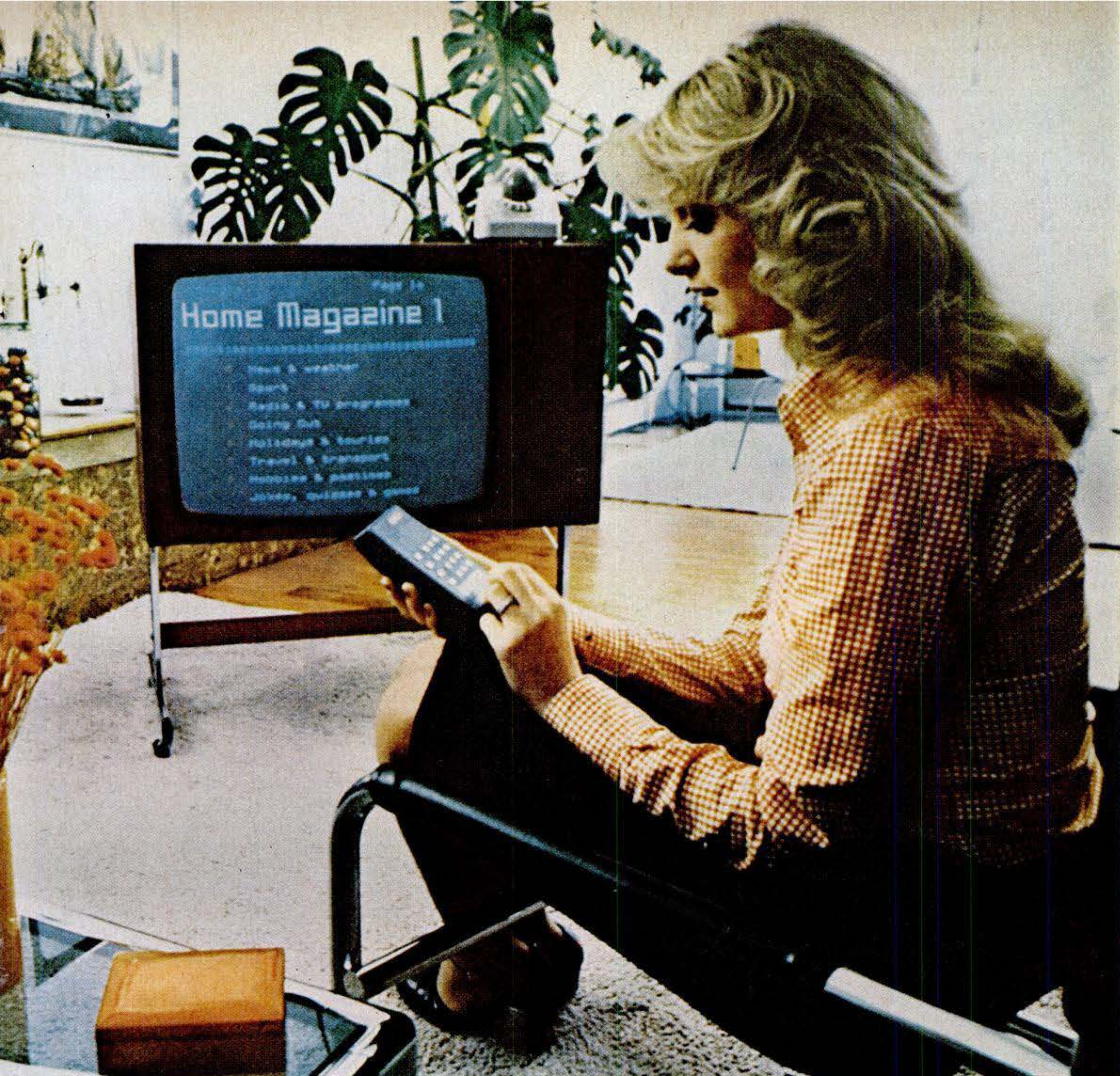
I come home and want the news headlines, latest football scores, or stock-market prices in a hurry, without waiting for the next news broadcast. Or I want to see the

local theater listings, racing results, or weather forecast. So I punch a few buttons on a small keypad, and the display I've chosen flashes on my TV screen in gaudy, eye-catching color.



Unlimited information is available to the user of new TV data systems. Graphs, such as the one in the Financial Times index (a composite average similar to the Dow Jones) shown above left, are easily displayed. To its right, a weather map shows country-wide conditions concisely. "ABC" in top corner indicates "rolling pages" that change automatically in

sequence for today's, tomorrow's, and long-range forecasts. Bottom left shows the Exchange & Mart Index for used cars. Viewers key reference numbers for further pages that give the alphabetical listings by model. The general index page for BBC's Ceefax, above, gives index page numbers, the time, and the date.



It's instant gratification, like leafing through an electronic encyclopedia of facts that are continuously updated, and seeing what I want to know—just when I need it—within seconds, and for free. Yet, at any time, I am able to switch back to all the usual TV channels.

Called Teletext, this British breakthrough in video communications—which may be coming to the U.S.—takes computer-display technology to new levels of sophistication.

"It uses existing TV transmissions to carry entirely independent digital signals that produce poster-like 'pages' of information from a computer," explained Geoffrey Sturge of the British Broadcasting Corp.'s Engineering Information Department. "Your home TV becomes a computer terminal." Color

sets can be adapted to convert these hitchhiking pulses into a screenful of type or simple graphic designs such as a weather map, and do this without interfering with normal reception.

Both the BBC and the Independent Broadcasting Authority (commercial TV) started limited service with this technology in late 1974. Though there are as yet only a few thousand suitable receivers in the country, different Teletext "magazines" go out on the various channels 16 hours a day. The BBC's brand name is Ceefax (See Facts); the IBA version is called Oracle (Optional Reception of Announcements by Coded Line Electronics). The systems are technically identical.

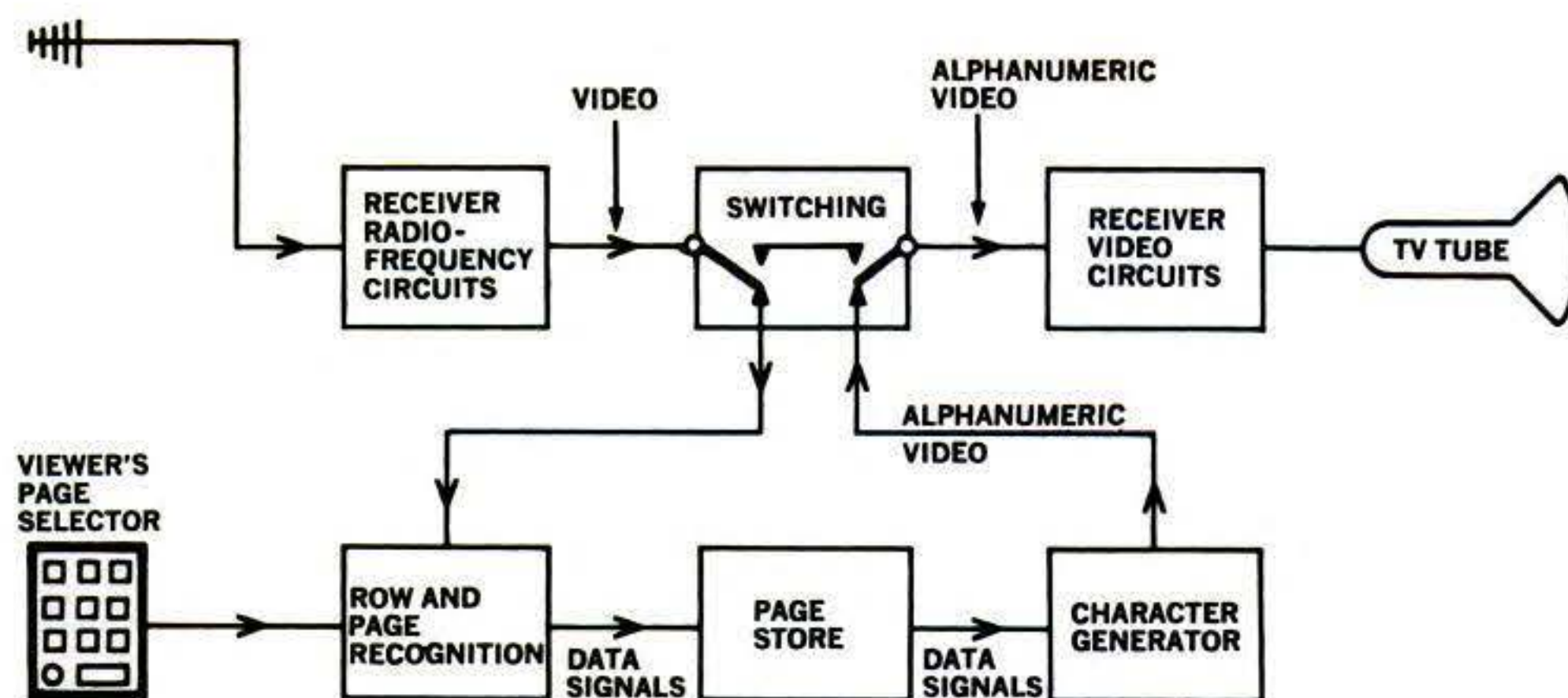
Now Britain's telephone company, operated by the Post Office, is

Remote keyboard in this Viewdata system selects a desired page of information such as this "home magazine" sub-index. Detailed listings for specific articles may then be chosen. Information is transmitted over home phone line.

joining the act with a similar service called Viewdata. This system pipes pulse-coded data from a central computer through ordinary phone lines, which can then be tapped off at any telephone. The modified TV is wired to the phone in the subscriber's home or office, and he presses keyboard buttons to select the page he wants, just as with Teletext.

Viewdata is compatible with Teletext and has the same standardized page format, but different facilities are available. "One ad-

Continued



BBC Ceefax system keyboard (left) gives fingertip control over hundreds of pages of news and information. Oracle on Britain's commercial channel has similar device. Basic layout of Teletext system used by Ceefax and Oracle shows how data is coded for display. For reception of information pages, the video sig-

nal is switched through auxiliary circuits that select, store, and generate the display you select. Written text can appear superimposed over a normal TV picture if desired. Viewdata input from the phone line is similar, but bypasses radio-frequency reception in favor of direct video signals.

vantage over the TV transmissions is a far greater store of information on tap," says John Darkin, head of Viewdata's International Marketing. "Another is a talk-back facility: One person can send written messages to any other having the equipment." A financial benefit for the Post Office is that subscribers have to dial a special number to connect with the service, and are then billed on a time basis as for local calls.

I tried it

Feet up on the living-room couch and sucking my pipe, I'm so engrossed in a BBC-2 whodunit that I've missed the 9 PM news on BBC-1. I punch the "page" button on the Teletext remote-control box,

and key in the three-digit number 200, the Ceefax index page for my channel. Then I press the "mixed" button, and instantly the headline appears in white characters across the top of the whodunit on the TV screen. My selected 200 is at the extreme left, and alongside that is a trio of rolling digits. In a few seconds this number reaches 200, and the screen floods with an index of available programs and displays.

News headlines are 201, so I press "page" again and key in the new 201 number. Soon the white, superimposed display changes to six short news items with referenced page numbers for each. I select page 204, an oil-tanker collision in the South Atlantic. Details of the disaster flash across the

picture I'm watching. Meanwhile, my whodunit movie has momentarily slowed, so I press the "text" button. Now my news story blossoms out in brilliant colors for easy reading and the background movie vanishes, though the sound continues. Enough news, so I now punch the "picture" button and my show returns—but any of BBC-2's 100 magazine pages are still at my fingertips.

After a week's use I found this electronic marvel to be a valuable adjunct to the home TV, and certainly easy to master. But you must weigh Teletext's usefulness against the current price, about twice that of an ordinary color TV set. When this drops to a reasonable level, say that of a mid-range phono turntable, I'd buy it. Even then, I'd also want Viewdata, the telephone service, because of the vast store of information it adds to this new medium.

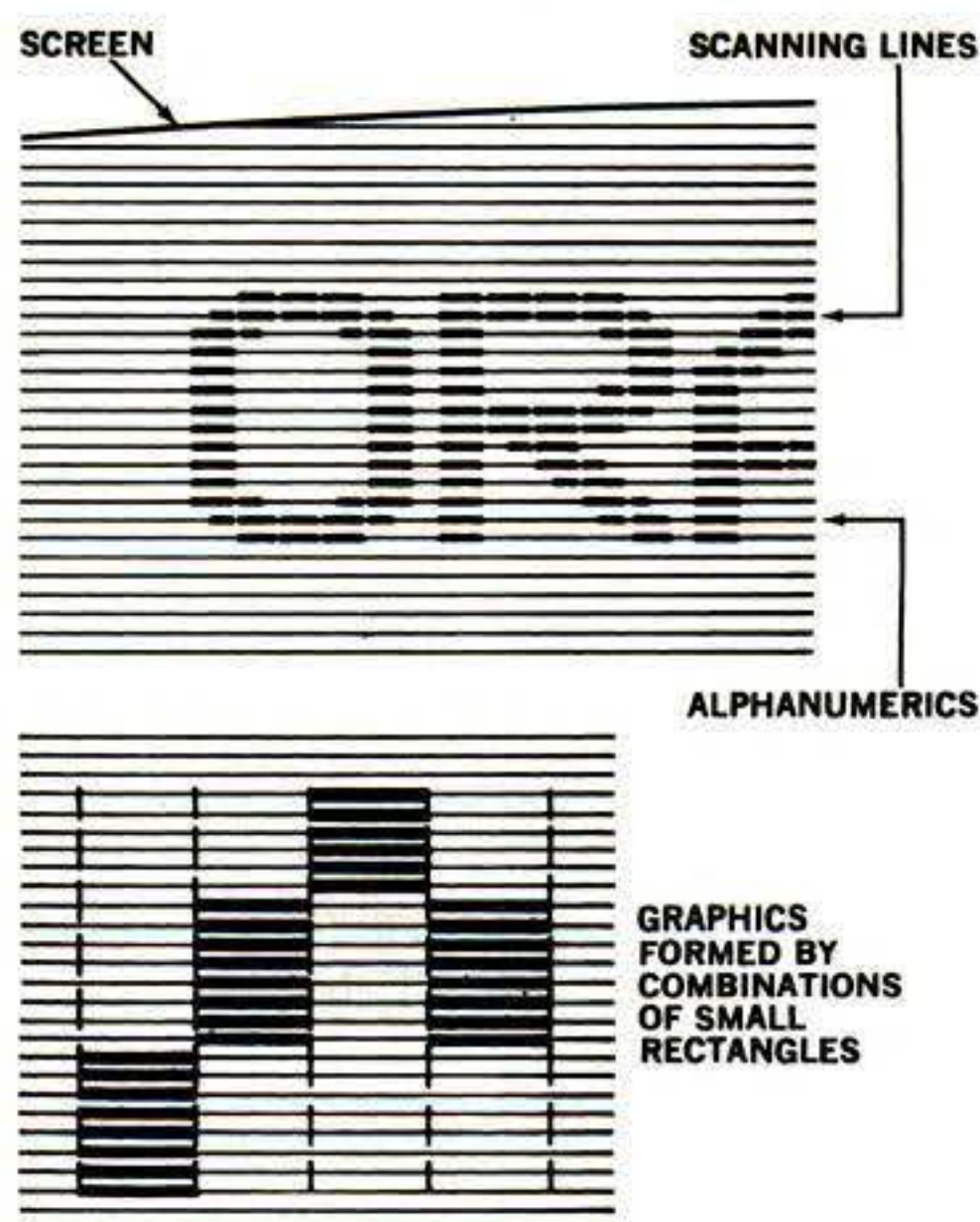
How does it work?

Both the TV and wire systems use the same basic coding technique. Incoming signals are stored in a memory circuit in the set. This holds enough data for one page of information, which can have up to 24 lines of text with 40 characters each. Every page is identified by a numerical code. When you select the number you want on the keypad, that particular page is extracted from the magazine stored in the central computer and held in memory. From here it is transferred to the screen as the video display, and stays there as long as you wish. Punch out another number and you get a different page.

Signals forming the characters are a series of on/off pulses, or



Alphanumeric keypad for Viewdata set lets you send written messages to other users anywhere on the telephone system. Messages are routed by subscriber's individual code number and stored in the central computer until requested.



Characters on TV screen are formed by binary digital pulses carried on unused TV scan lines. Coding controls on and off states of the electron beam, creating individual rectangles on the picture tube that form characters or graphics.



binary digits, known as "bits." Each letter and number has an individual eight-bit code (a "byte"). All the information needed to produce a screen-size page is contained in these bytes, including upper- and lower-case letters and color. Six different colors plus white are activated by special coding in the composite video signal.

TV and wire services differ in the transmission method. Like all TV, Britain's 625-line system has several scanning lines that are not visible on the screen. They are unused to allow time for the electron beam, which makes up the picture, to get back to its starting position after each scanning sequence. Four of these empty lines are used to carry the digital (on-off) coding sent out simultaneously with the analog (wave pattern) picture signal. This digital component of the video is then stored and decoded into words and symbols.

At the BBC Television Center in London, I saw newscasters feeding their stories into the Ceefax computer using electronic keyboards of visual-display units. From this databank, the magazine pages for each channel are broadcast in sequence, as on an endless tape loop.

But the interval between successive pictures is only long enough to send part of a page at a time. While each complete page takes only a quarter-second to trace on the screen, these eye-blink periods can add up to a delay of many seconds before the selected item appears on the screen if it happens to be near the end of the rolling cycle when you call for it.

Because of this bottleneck in the TV system, the BBC limits Ceefax

to 100 pages per channel to keep maximum access time down to 25 seconds. The IBA stretches Oracle's store to around 350 pages, and there can be an even longer wait.

Viewdata, in contrast, gives virtually immediate access and therefore can store thousands of pages; it's limited only by computer capacity. That's because the user is in direct contact with the computer via the phone line, and his selection is served up the instant he keys in the page number. It's the difference between swinging a pick-up arm across a record to play a different track and waiting while a tape reel winds onto it.

Coded signals coming back through the line are audio tones, because telephone cables and exchange equipment are suitable only for analog signals. A modulator-demodulator (modem) in the set converts these warbling notes into digital coding, and this feeds through an input processor and memory directly into the video circuit of the TV.

Although the response is instant, it takes an average of five seconds for a full page to reach the screen. The reason is that the telephone system is designed for voice frequencies, and the bandwidth can only handle pulses whistling through at a top rate of 120 written characters or three lines per second. Still, that's faster than you can read, so it's no problem.

Viewdata stores it

The Post Office is currently storing 10,000 pages of information at the Viewdata base near Ipswich, and there is enough computer capacity for 70,000 pages. Viewdata already includes topics on every-

Ceefax newsroom at BBC Television Center has a bank of keyboard visual-display units. Local and wire-service news is typed directly onto multicolored pages for instant transmission. Existing pages can be updated in minutes.

thing from business news, rail and air timetables, and public announcements, to cooking recipes, gardening hints, job vacancies and "Yellow Pages" directories. Libraries, educational courses, or quizzes for kids also leap onto the screen at a touch of a button. And, since there's two-way communication, you can play games, answer test questions, or even ask your bank for a statement. Personal numbers can be used to route written messages between subscribers. A special alphanumeric keyboard working through the modem lets you transmit your own texts and opens wonderful new doors for the deaf. Also, any page or pages of text, such as timetables or long recipes, can be recorded as tones on a simple audio cassette and played back at leisure without running up the phone bill. The vast range of specialized information this makes possible would be far broader than on Teletext, which concentrates on hot news items. The two systems are regarded as complementary.

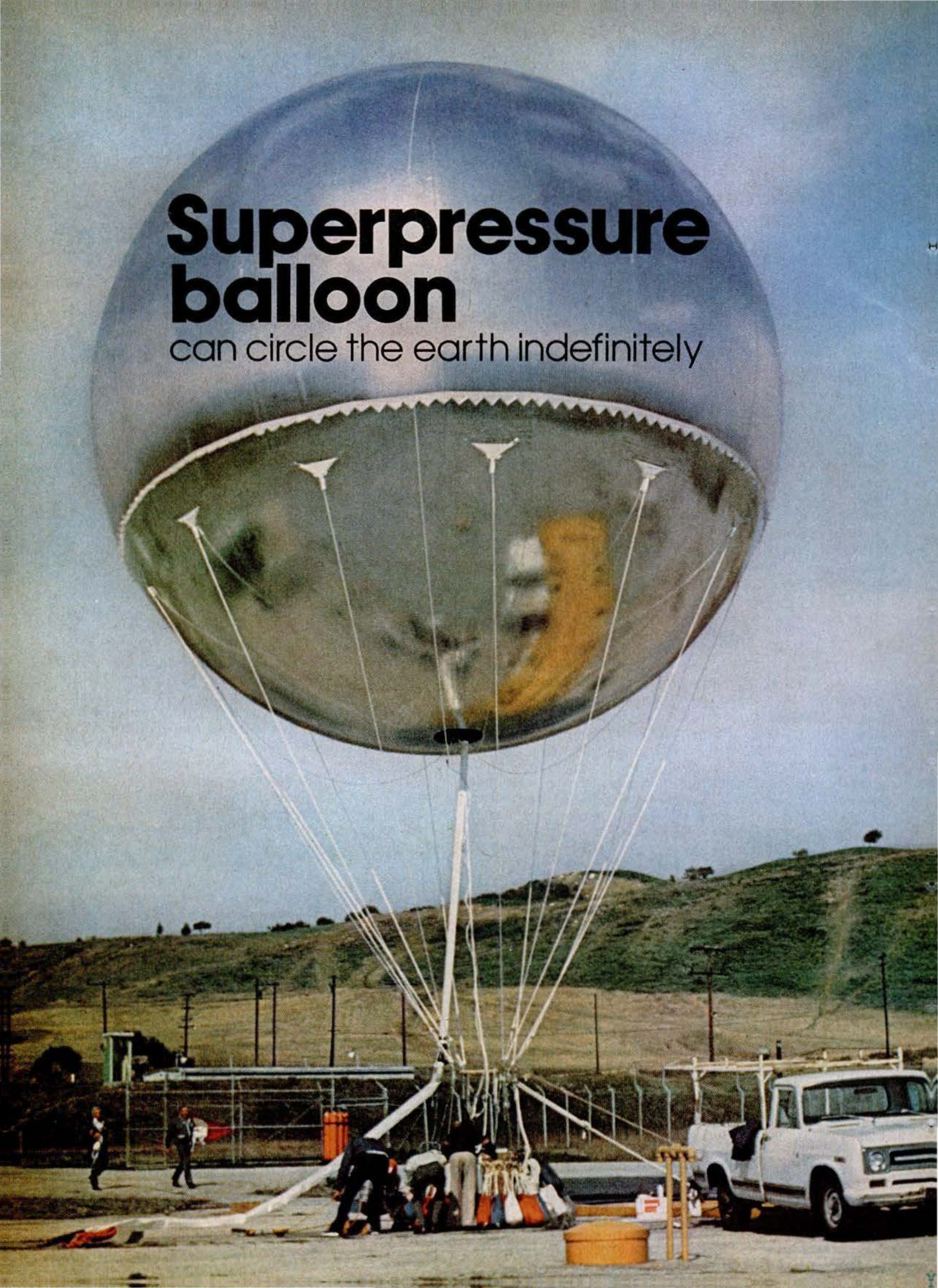
The Post Office is now winding up its pilot-trial phase, and in June 1978 starts market trials with adapted sets wired to the phone lines in 1000 homes and offices in London, Birmingham, and Norwich. There will be 60,000 pages of information in a new London databank, and the testing will evaluate the demand for particular pages, user responses, how long and at what times people use the line, and the revenue potential.

The BBC, with Ceefax in its fourth year, isn't concerned with the business side, because it's funded by compulsory viewing licenses covering normal reception and carries no advertising. Oracle on the commercial channels is a business operation and is financed by advertising in the form of sponsored pages, classified ads of all types, and payments for brand-name mentions such as flour in cooking recipes. This would likely be the pattern for American TV.

Last October, the Post Office demonstrated Viewdata at an international telecommunications conference and exhibition at Atlanta, Ga. It conjured up thousands of information pages drawn from the databank in Britain via Atlantic cable. U.S. telephone people were mighty impressed. [E]

Superpressure balloon

can circle the earth indefinitely



By **MARK DAVIDSON**
and **NIRMALI PONNAMPERUMA**

Until recently, balloons have had one drawback—their inability to stay aloft indefinitely. A hot-air balloon's flight time is limited by the amount of fuel it can carry to heat the air in the balloon.

Gas-filled balloons have a limited flight duration because the gas inside expands as it gets warm. This requires a hole in the bottom of the balloon to vent the expanding gas—otherwise, the balloon would burst.

When the sun goes behind a cloud, or at night, gas in the balloon contracts. The balloon shrinks and starts descending. Ballast, such as bags of sand or water, is then dropped to maintain altitude. When the ballast is used up, your flight has ended.

But all this has been changed with the development of the superpressure balloon: The gas is sealed in a strong skin, and the pressure inside the balloon is greater than the pressure outside. So, even when the gas inside the balloon gets cold, the balloon remains the same size. You don't need to keep using up ballast to maintain altitude.

Right now, the world's only pilot of a superpressure balloon is its developer, Thomas Heinsheimer, an aeronautical engineer and physicist with the Aerospace Corporation, a nonprofit research and development center in El Segundo, Calif. Heinsheimer's \$65,000 prototype superpressure balloon, which he calls an "ATMOSAT," stands 55 feet high, has a 33-foot diameter, and is made of a three-layer skin of Mylar and tough-as-steel Kevlar. It holds 18,000 cubic feet of helium, and carries a 12-line suspended gondola of Kevlar and aluminum, with an array of flight and atmospheric measuring instruments. Principal co-designer and co-pilot of the balloon is Peter Neushul, president of Neushul, Inc., a firm that makes aircraft equipment.

The balloon's first experimental flight was February 18-19, 1976, from Palos Verdes Peninsula. The balloon sailed out over the Pacific, crossed over San Diego and Baja California, and concluded with a gentle landing near the Mexican border at Lukeville, Ariz., 30½ hours after it lifted off. Flying at levels between 1500 and 6000 feet, the balloon moved with extreme stability, demonstrating its suitability for carrying precision atmospheric monitoring equipment.

The second flight, with lift-off exactly two months later, originated from an airport at San Angelo, Tex. From there Heinsheimer and Neushul drifted over New Mexico, Oklahoma, Colorado, and into Kansas. They had hoped for a flight of two or three days, but a thunderstorm made them decide to land in a Kansas wheat-field after they had spent 31½ hours aloft.

The third flight, from Palos Verdes, proved the balloon's pollution-monitoring capabilities over such densely populated areas as the Los Angeles basin. Heinsheimer and Neushul were able to linger over the basin for 20 hours, observing smog levels and simulating long-term pollution measurements. Later, they observed pollution pockets over the pine-covered mountains of Crestline and then drifted over Lake Arrowhead and Barstow. After 32½ hours, air turbulence made them decide to land on rocky terrain in Death Valley, where 30-knot winds dragged the gondola over the rugged surface for half a mile before they crashed to a halt. Heinsheimer suffered multiple bruises and a back injury, but Neushul escaped unharmed. They were rescued a few hours later by park rangers, and the damaged craft was retrieved by helicopter.

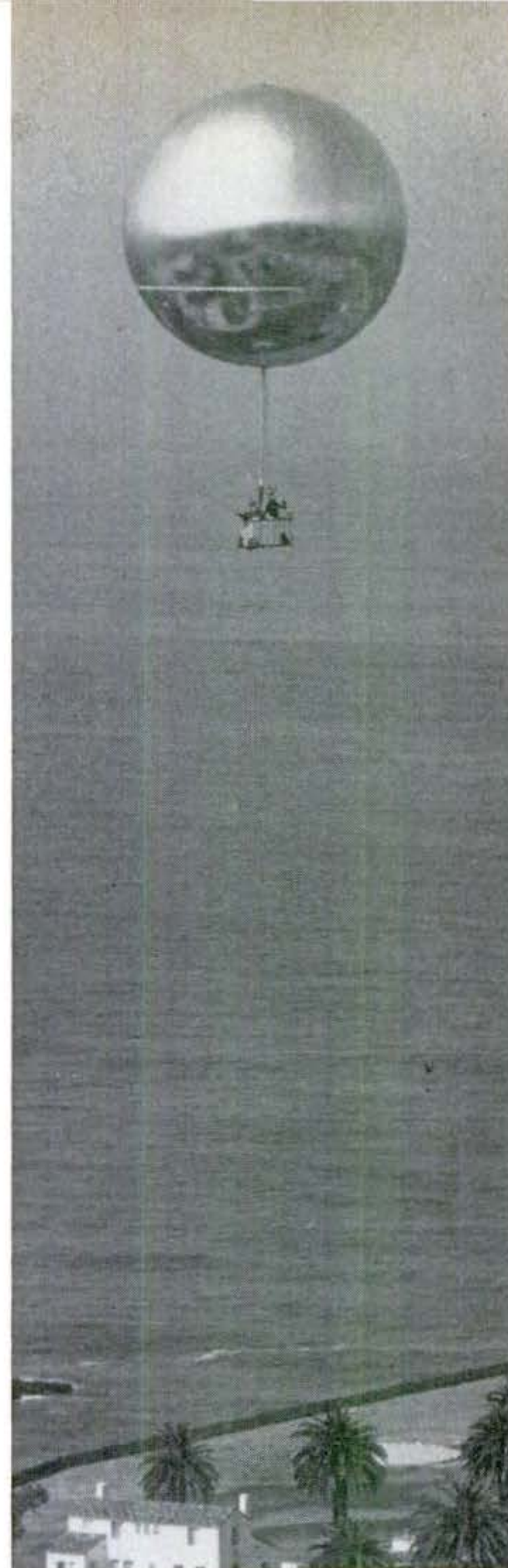
Pollution monitor

Five months later, on December 8, crew and craft were ready to fly again. The balloon was packed into a trailer and taken to Farmington, N.M., where that state's Environmental Improvement Agency wanted the aeronauts to collect "grab samples" while floating with a smoke plume generated by the Four Corners Power Station.

Weather conditions dictated a night flight, which lasted seven hours, by which time they had drifted with the pollution plume from New Mexico into Colorado and Utah. They landed smoothly in a field a few miles outside Monticello, Utah.

During 1977 Heinsheimer accepted more pollution-monitoring missions—one from the city of Albuquerque, N.M., and three from Southern California's South Coast Air Quality Management District.

"Our purpose," Heinsheimer says, "has been to show the unique contribution a balloon satellite can make for monitoring the atmospheric environment, complementing the equally valuable collection of data by planes, rockets, and space satellites." 25



Superpressure balloon, named "America" by its designers, makes its maiden flight off Palos Verdes Peninsula, Calif.



Small gondola houses Neushul, left, pilot Heinsheimer, and instruments for measuring atmospheric conditions.

Indoor barbecue

Add one to kitchen or den, and couple it to a wood range

Wood-burning range, an Austrian Tirolia, was built into stone alcove with an indoor barbecue (right). Stove is engineered to cook efficiently with minimum fuel.



Couch corner, above, was transformed into wood-based cooking center 80 in. wide, 88 in. high, 40 in. deep. Brick column behind stove (right) encloses the stove-pipe. Chimney for range/barbecue center is top right. The brickwork was completed by a professional mason.



New wood burners are efficient cookers, and can cozy up a room to save heat next winter

By MARTHA HERRINGTON

If you're fed up with rain ruining your outdoor barbecues, or miss the taste of steaks sizzled over hot coals during cold winter months, why not build an indoor barbecue?

We decided to add this wood-fired cooking center for two reasons: the threat of rolling blackouts during last year's California drought, and the thought that, although the

range is most attractive in cooler weather, the barbecue can be enjoyed all year—in all weather.

We'd been warned to expect short-duration power outages that would cut off electricity for cooking or heating, but not last long enough to endanger food stored in freezers. Even though our drought ended, the continuing energy problems that plagued many areas of the country last winter make wood-based cooking and heating centers sound like good insurance.

Our contemporary home doesn't lend itself to one of the older cast-iron stoves, so after some research we located a modern-style, attrac-

tive, enameled-steel model to be paired with the indoor barbecue.

The Tirolia stove we selected features efficient airtight construction. It burns wood, coal, or even scraps. (We've found it economical to burn shards of oak left after we use our big log splitter—pieces too small for the fireplace, but perfect for the small firebox of the stove.)

The stove top has high-, medium-, and low-heat zones; oven size varies according to the model you select. We also found the stove kept our kitchen at a comfortable 70 degrees throughout the night, all winter.

Construction of the range/barbecue center was less of a problem and created less of a mess than expected. After planning the layout, we hired a mason to complete the extensive brickwork for the center and its chimney.

Masonry support

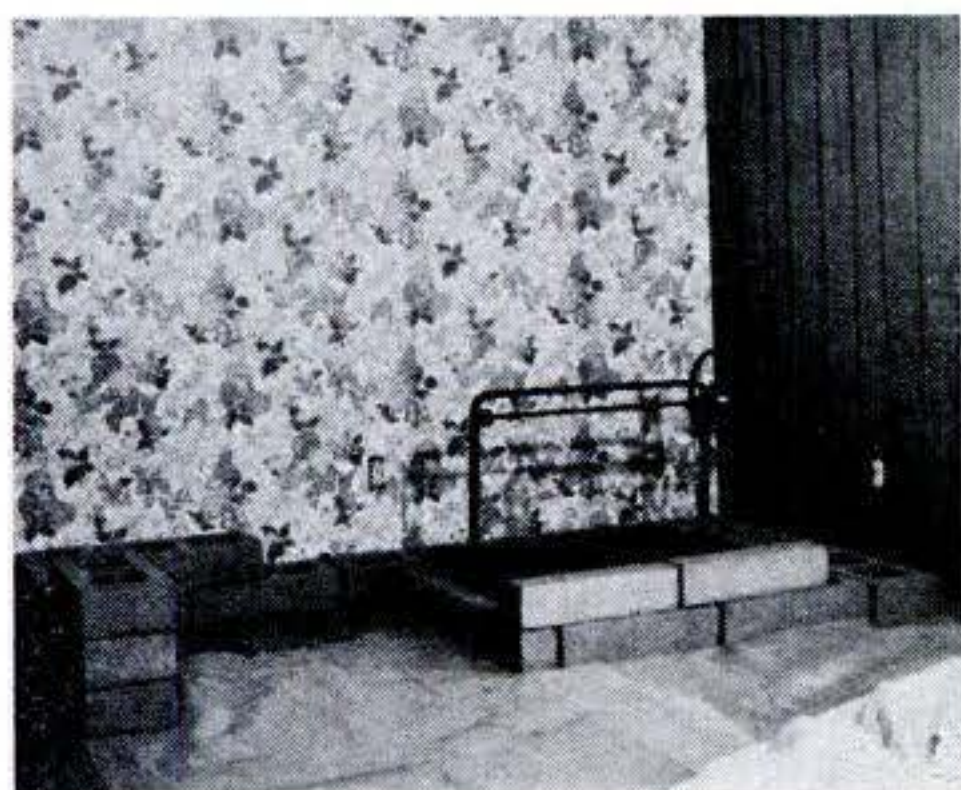
Stacking this much brick (plus chimney) on the suspended floor of our family room created a weight problem. If you were erecting such a unit on an existing concrete slab, you'd probably have little or no foundation work to do.

We simply cut a hole right through our floor where the heaviest (chimney) section would go, and dropped a rough form through to rest on the ground of the crawl space below. Then we dumped concrete through the hole into this form and let the four-inch foundation pad set for a week before building up from it with concrete block, as shown in the photos.

I've found that a range/barbecue center can save a great deal of energy, and create a pleasant ambience in a kitchen or family room. Such a center can stimulate a return to ignored recipes and cooking styles. I plan, for example, to put my long-retired soup kettle back to work.

23

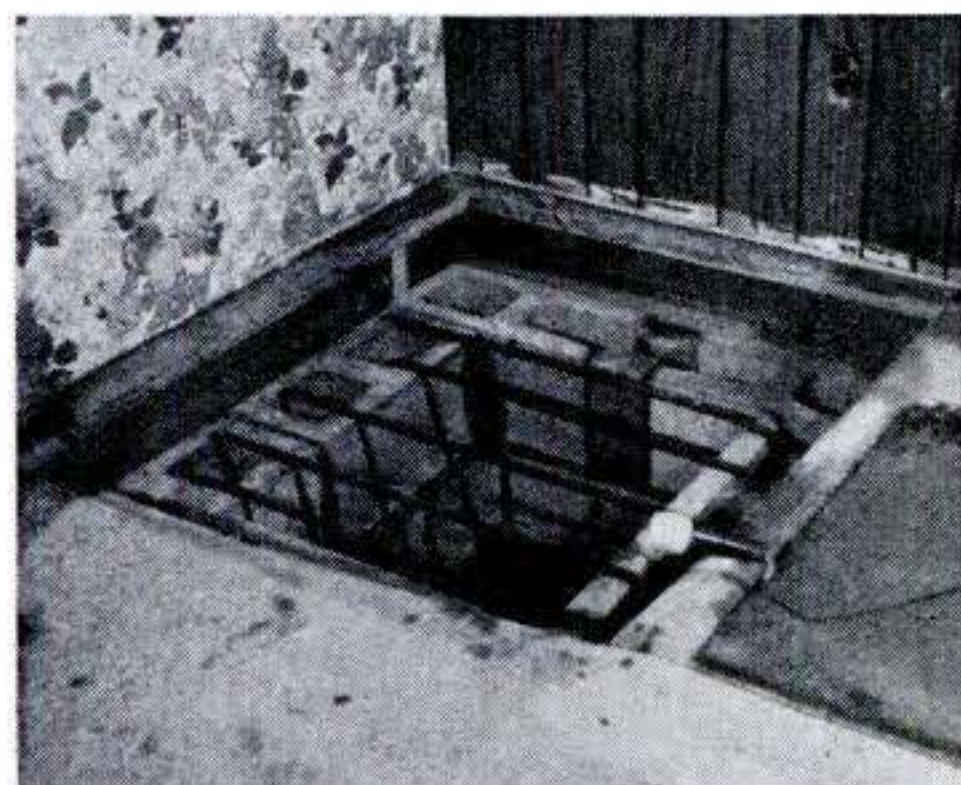
Planning and laying the masonry



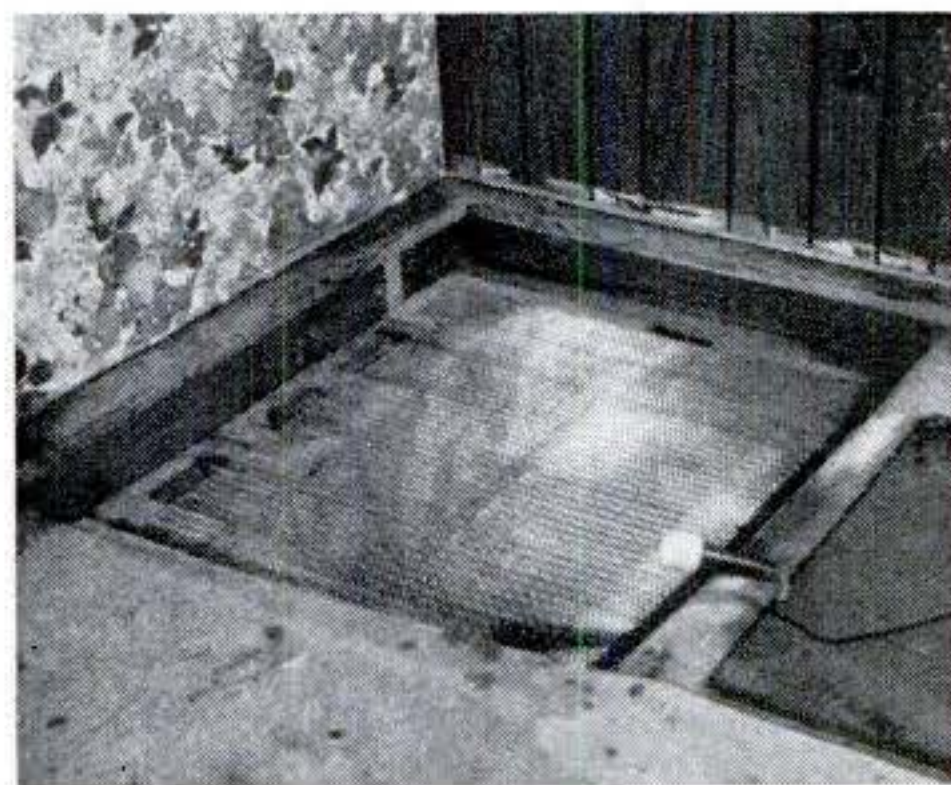
Dry layout, using barbecue grill (right) and measurements for range, helped determine suitable size and structure.



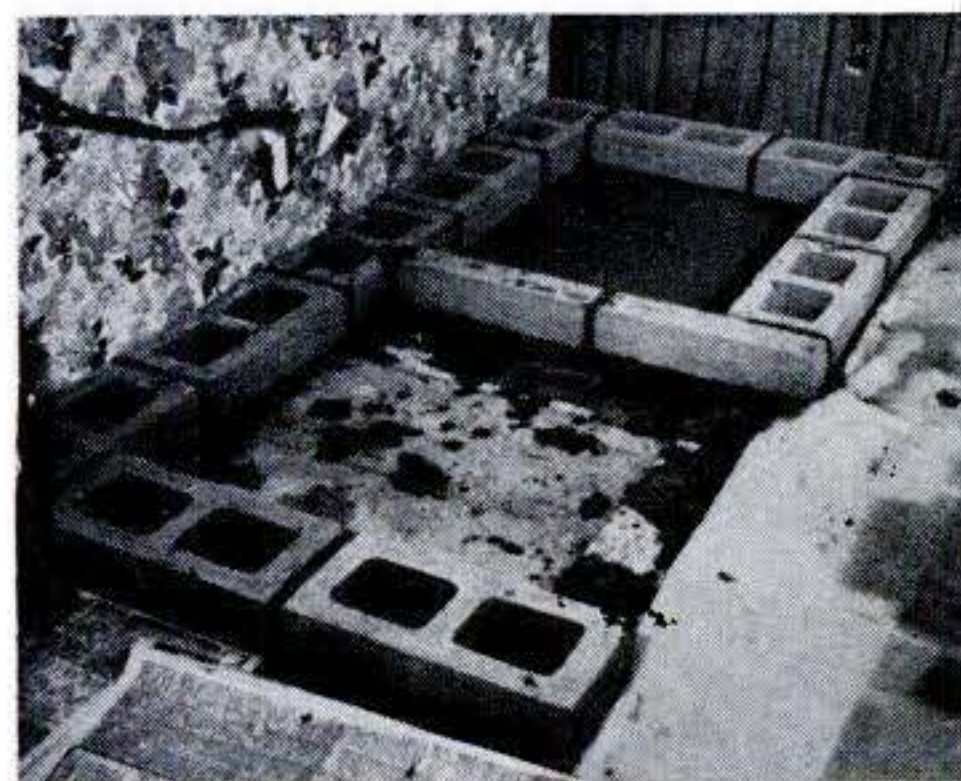
Pouring cement through hole cut in floor provides firm footing on which to erect foundation for heaviest masonry.



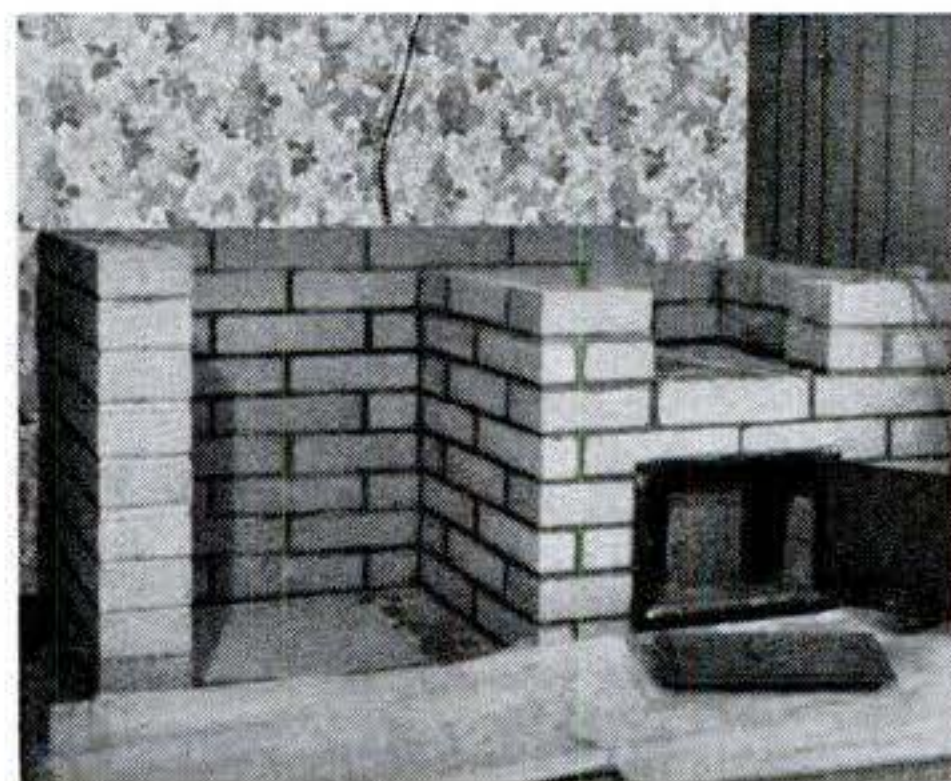
Cement blocks on pad built up to three inches below floor level have steel re-bars laid across top.



Expanded-steel lath is laid on re-bars, and concrete is smoothed on top to form slab flush with floor.



Bottom course of 270-odd slump-stone bricks used for cooking center establishes shape of open stove niche.



Steel storage door is shown installed and open; in front, butterfly draft door ready to be installed above it.

MATERIALS AND DIMENSIONS FOR INSTALLATION SHOWN

Slump-stone bricks (3½" × 15" × 15")—about 250
Slump-stone bricks (3½" × 7" × 7")—about 20
Fireclay, cement, sand, and ½" re-bar
Steel support plates (½" × 6")
Benson barbecue grill, 18 × 24"
Two steel doors—Miller Materials Co.
Wood-burning stove—Tirolia of Austria model D5N
Fluorescent light fixtures (15-watt)—2

Measurements for center: 40" front to back, 80" wide, 88" high. Stove niche: 29¾" wide, 32½" deep, 34½" from floor. Barbecue area: 28¼" wide, 32½" deep, 37" high from floor. Opening: 31½" high.

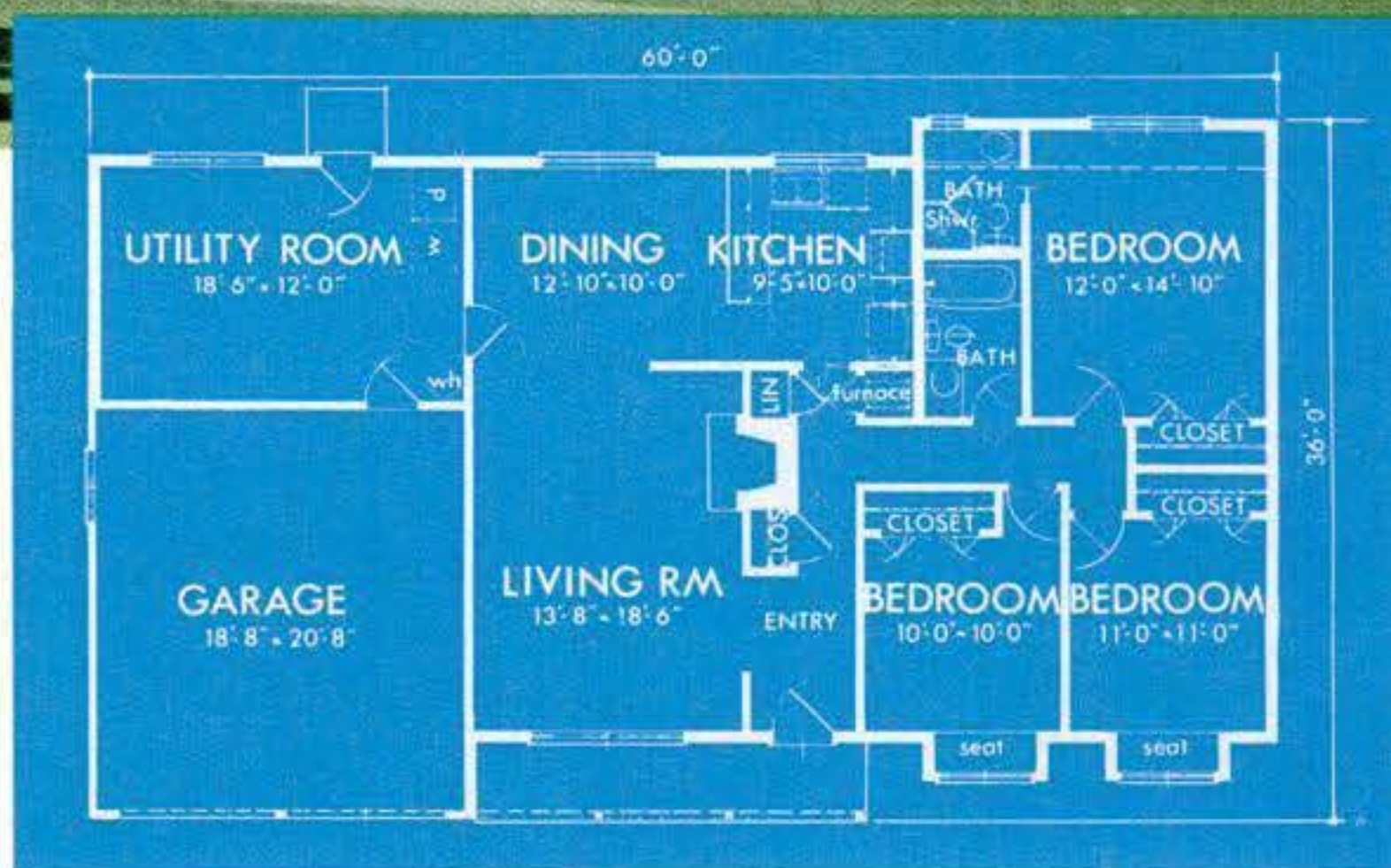
MANUFACTURERS AND SOURCES

Tirolia ranges: "Old Country" Appliances, Box 330, Vacaville, Calif. 95688. Grill parts and grills: Miller Materials Co., 797 Marina, San Leandro, Calif.; Benson Barbecue Mfg., 950 E. El Camino, Sunnyvale, Calif. 94087.



PS leisure-home plan

Plen-wood house



By AL LEES

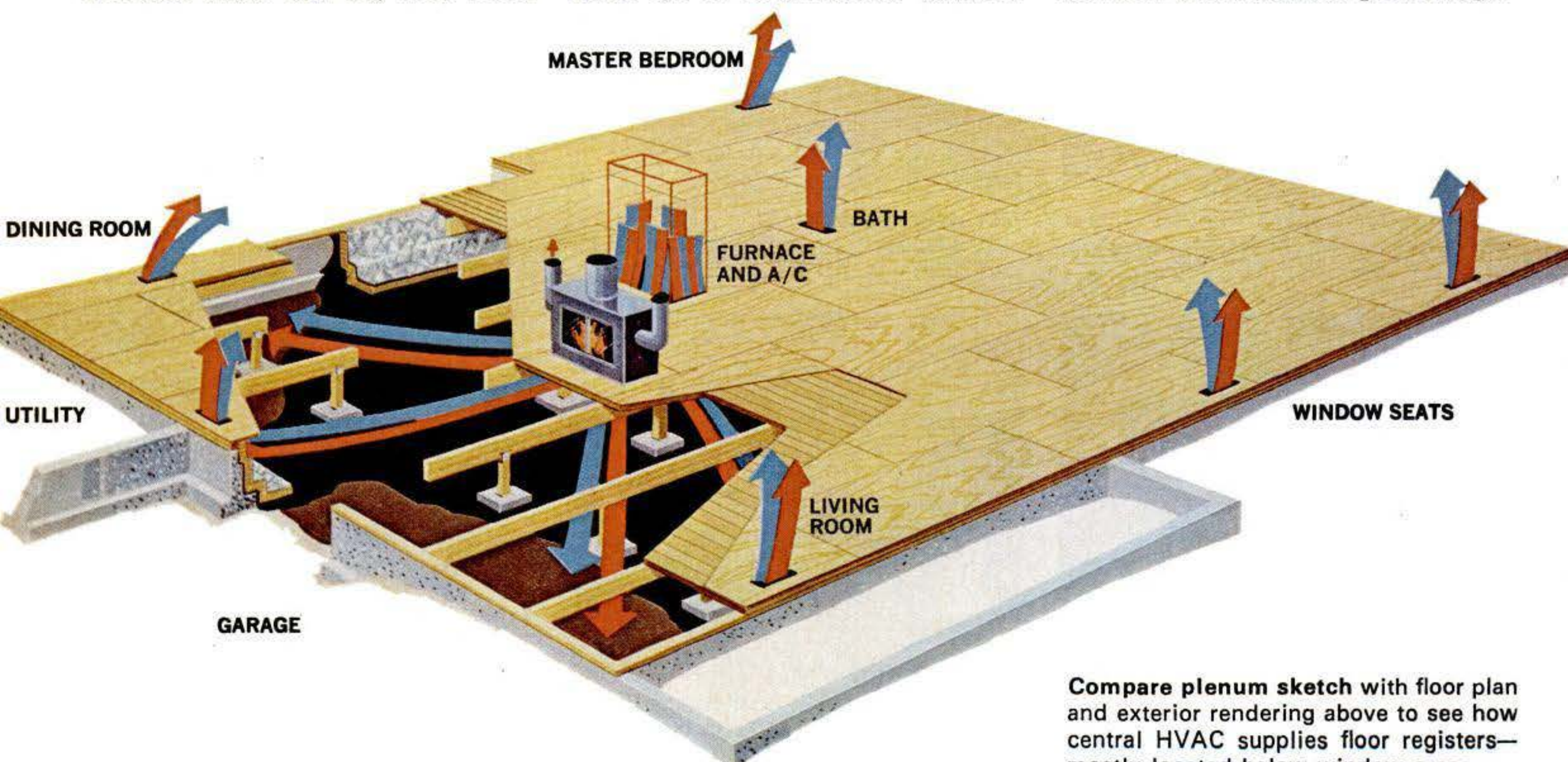
We first told you about a radical new construction method that uses a sealed crawl space to distribute heated or cooled air—eliminating conventional ductwork—in our January 1977 issue ["Underfloor Plenum," page 98]. The booklet we mentioned then—*The Plen-Wood System Manual*—is still available for 25¢ in coin from Western Wood Products Assn. (SP-3), 1500 Yeon

Building, Portland, Ore. 97204.

But readers wrote us asking for house plans that incorporated the Plen-Wood system, so it seemed logical to get back to WWPA—a lumber association that also participates in our leisure-home series by commissioning designs for us from Home Building Plan Service. Together, they came up with this "economy model," which, at 1267 sq. ft., would make a fine second home for a conventional vacation

site, or could be constructed as primary housing.

The house is not only economical in energy use but is a dollar-saver to build. It's a compact, straightforward design that packs three bedrooms, two baths, and ample closet space into the basic 1267, then tacks on a 610-sq.-ft. two-car garage and a 247-sq.-ft. utility room—both of which could be omitted for a small vacation home plot. (They *are* omitted from the underfloor plenum sys-



Compare plenum sketch with floor plan and exterior rendering above to see how central HVAC supplies floor registers—mostly located below window areas.

tem; if you wished heating or cooling in either of these areas, you'd have to install room heaters and window air conditioners.)

The only floor-plan requirement for such a system is that the down-draft heating/cooling unit be centrally placed. This house tucks it into a hall niche, just behind the heat-circulating fireplace. Since the latter is a modern, zero-clearance unit, additional closet space can be snuggled against it on both sides—as long as you allow for the ducts.

The fireplace improves heat circulation by drawing in cooler air near the floor for combustion, then delivering it through ducts to two wall registers. One of these registers could face back into the living room while the other might feed its hot air into the entry hall.

The rest of the house is heated and cooled via the underfloor plenum, as shown in the diagram. As the red (heating) and blue (cooling) arrows indicate, the central downdraft moves air under the wood floor to perimeter registers. The rooms are thus heated or cooled both by convection (air through the registers) and conduction (through the floor). This produces a more uniform temperature, floor to ceiling, than with conventional systems. And when the floor is warm, there are no cold feet in the house, so there's less temptation to sneak the thermostat up.

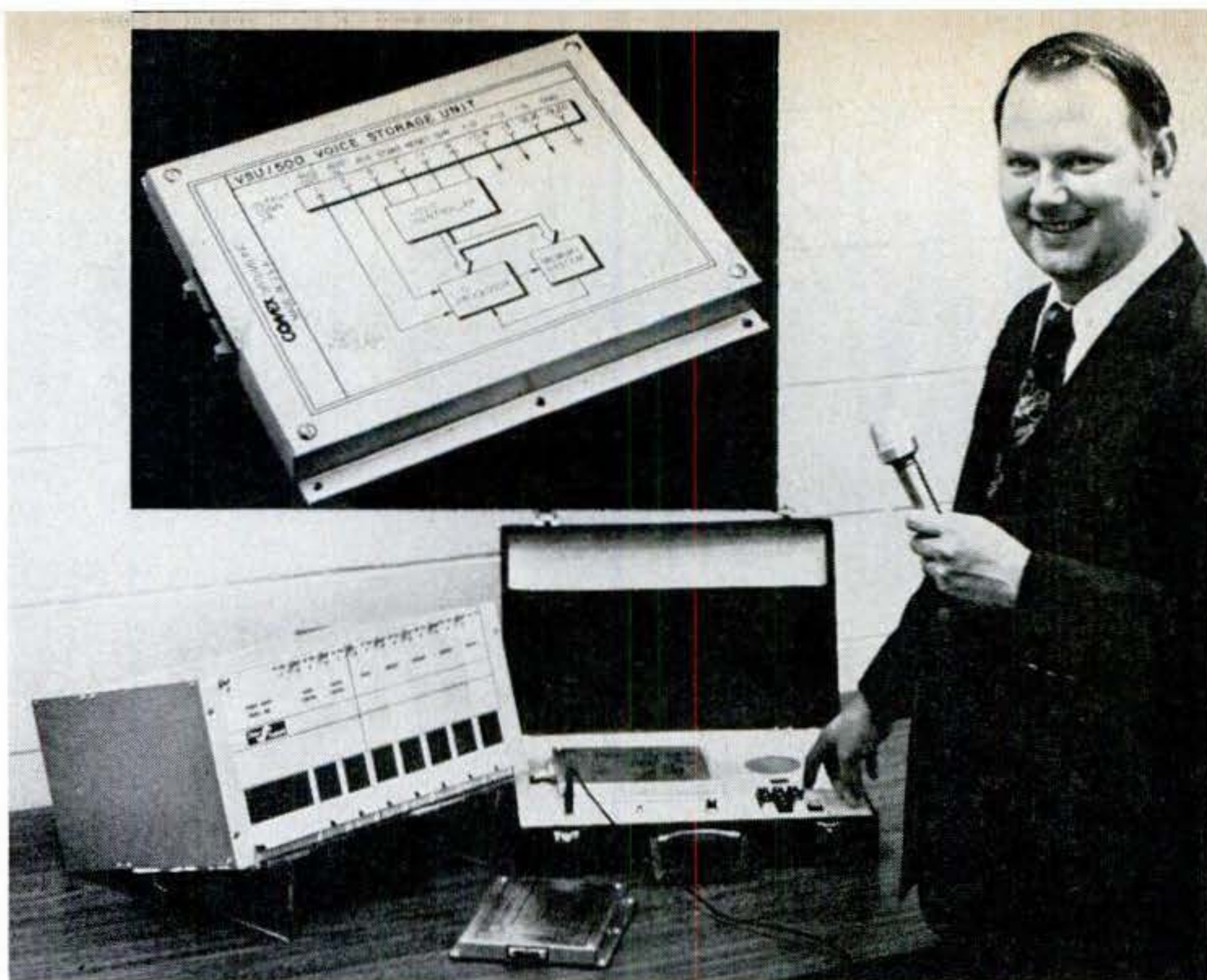
The floor shown in the color sketch is a variation on the glued-plywood floor shown in our earlier Plen-Wood article, where the sheets were nailed directly to the joists. Here, the ply panels are laid over a t&g plank subfloor that's nailed at right angles to the more-widely-spaced joists. The wider spacing improves air movement.

The simple rectangle of this plenum floor space is more efficient than an irregular or L-shaped plan would be. The sides of the plenum can be insulated masonry walls, as shown in our sketch, or an "all-weather" wood foundation (WWPA can also supply a brochure on that).

For still further economy, the two baths back up on the kitchen wall to minimize plumbing runs. **ES**

How to order your plans

One set of professionally drawn plans for the Energy/Cost-Saver is \$60; four sets (for building, financing, and permits) are \$75. Plans will be reversed, side for side, for \$12. A building-materials list is \$10. Specify plan 1389-1A. Orders and inquiries to: Home Building Plan Service, 2235 N.E. Sandy Blvd., Portland, Ore. 97232.



Solid-state record/playback module mounted in a briefcase recorder is demonstrated by Comex president Gary Stapleford. Compact modules (inset) store

brief voice messages in integrated circuits. At left is a mockup of a Time Tunnel, a module-based device that can delay voices on radio talk shows.

Tapeless recorder has no moving parts

"Sorry, 5 . . 5 . . 1 . . 6 . . 3 . . 2 . . 1 is not a working number."

Ever find yourself trying to argue with a recorded telephone message? Well, get ready for more disembodied voices in stores, banks, airports—even verbal roadside warnings that you're speeding.

The use of automated voice messages has expanded greatly, aided in large part by strange recorders that work without tape or moving parts. In these devices, voice signals are converted into on-off digital pulses—much like data in computers—and stored in integrated circuits (IC's). Voice signals in IC's can be recovered almost instantly—not true of conventional tape recordings. Linked with computers, the new recorders can perform remarkable services. And since they're motionless, the new recorders don't have the mechanical and maintenance problems of endless-loop tape machines.

One firm, Comex Systems, Inc., of Hudson, N.H., packs two types of motionless recorders into paperback-book-size modules. Its VSU/500 records statements up to 12.5 seconds long. The VSU/600 holds up to 16 messages, each about 0.6 seconds long, such as words to be pieced into sentences. Modules can be linked together to boost record-

ing time, but costs go up rapidly.

The Comex modules record and play back actual human voices, unlike electronic voice synthesizers, which generate on demand waveforms simulating human speech. Module circuits sample audio signals thousands of times each second, converting them into digital form. Comex uses a proprietary process that compresses 12 digital pulses into six for more compact storage. For playback, recalled data is expanded almost to its original form, then converted into an output signal to drive a loudspeaker.

At present, Comex recorders store voice signals in charge-coupled devices (CCD's). This type of IC requires constant electrical power to retain its signals. But the firm later expects to use magnetic-bubble memories ["Microelectronics," PS, Jan.] that remember even when electricity is switched off.

Potential applications? "If I'm going to work with a machine, I'd like to talk with it," quips Ron Weisen, who handles Comex's outside marketing. The future, he believes, could bring cars that ask for an oil change, clocks that announce the time, patient monitors that page doctors over hospital PA systems, or elevators and typewriters that talk to the blind.—Bill Allen



Four kinds of peppers, tomatoes, celery, zucchini, and more grow in six-inch-wide by 10-foot-long hydroponic terrace garden (top). Watercress unit (above) produces abundant—and delicious—crop. Tomatoes (right) were grown indoors in south window, then finished under four wide-spectrum grow lights (on 16 hours a day). Pollination can be a problem indoors. Author shook blooming vines and sprayed flowers with "Blossom Set," a hormonal spray.



Modular hydroponics

—plant-growing systems that fit any space

By V. ELAINE SMAY

When I need watercress for a salad, I pick it from a container in my east window. When I serve luscious red tomatoes, they probably grew under lights in my bedroom. In the summer, I raise zucchini, peppers, celery, beans, and a host of other vegetables on a five-by-10-foot terrace. I get maximum production from my small growing space because I garden hydroponically.

If you read my report in the March issue ("How to Grow Lush Gardens Without Soil"), you already know that hydroponics is a gardening method that uses no soil. Instead, the plants grow in an inert growing medium (gravel, sand, perlite) that supports them and provides aeration for the roots. Periodically, a nutrient solution that contains all the 16 elements a plant needs is delivered directly to the roots. Since the plants don't have to develop extensive root systems in search of food, you can grow more in a given space. And since all their nutritional needs can be met perfectly, you tend to get healthier plants and bigger yields.

I had been toying with the idea of trying hydroponics for a year or two, but all the ads I saw and all the brochures I examined showed hydroponic units that were unattractive—to my eye or my pocketbook. And I wanted more growing space than the small hobby units usually provide. The units I finally found are shown in these photos. They come in many sizes, are simple to set up, and are pretty much foolproof to operate. Also, they're relatively inexpensive, and I think they're very handsome. A small

company called Homeland Industries, Inc. (95 Evergreen Ave., Brooklyn, N.Y. 11206) makes the systems and ships them all over the world. The design was developed by Homeland's president, Barry Piesner, an amiable New Yorker who dreams of turning every flat roof into a garden.

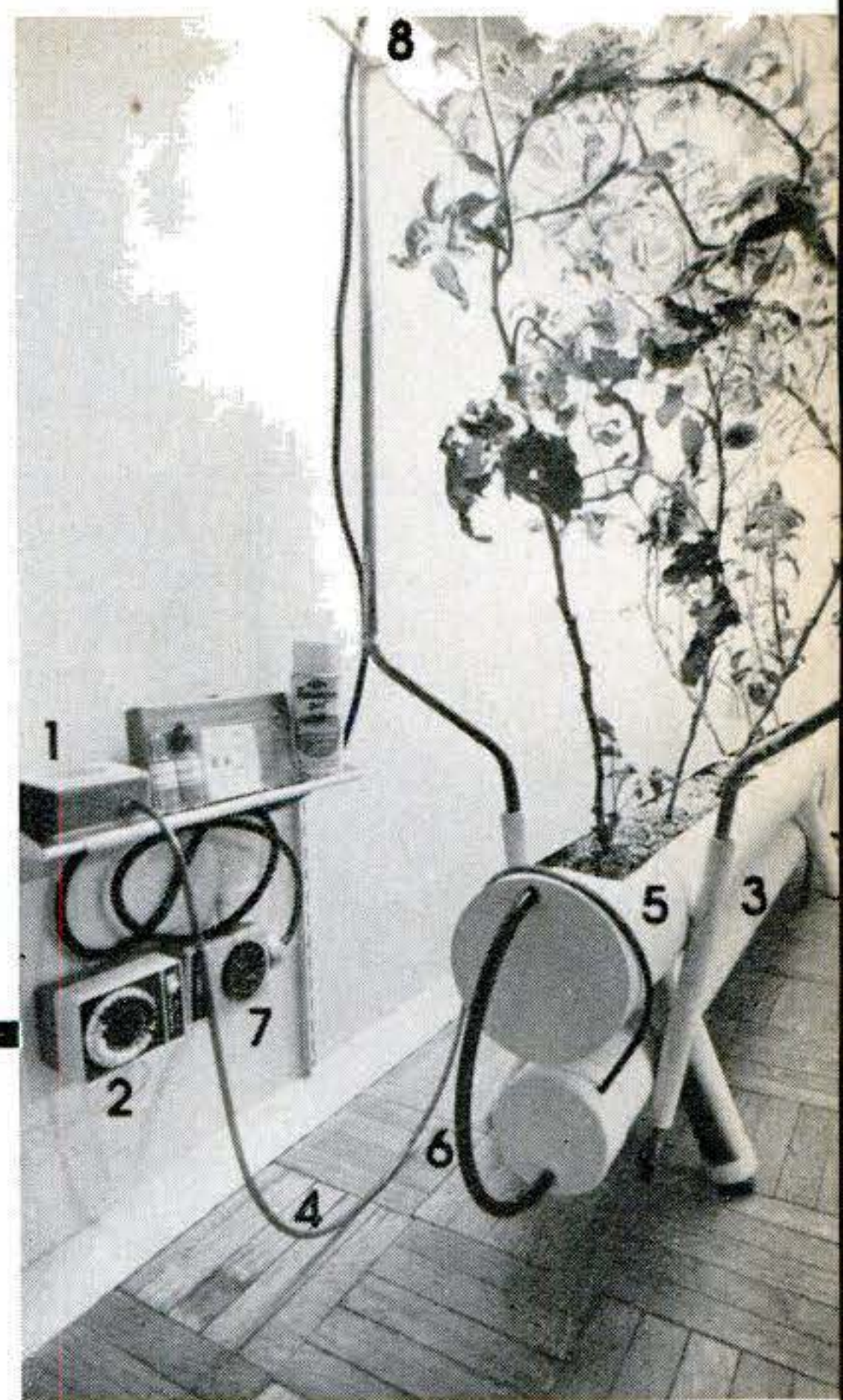
The system he developed is as elegant in design as it is in appearance. The growing bed is a six-inch PVC pipe; it's connected to a four-inch pipe that holds the nutrient solution. A simple aquarium pump, regulated by an inexpensive household timer, delivers the nutrient to the roots of the plants.

Barry calls his system Modulponics, because it's available in practically any size, from 2½ feet long on up, including commercial systems for many acres of hydroponic farming. The unit on my terrace is 10 feet long and sells for \$220. The five-foot unit that I use indoors (under grow lights) costs \$140. Those prices include the pump, timer, perlite and gravel growing media, and a four-to-six-month supply of nutrient concentrate. The light unit, which fits into the growing module, sells for \$120, including four bulbs and a timer.

The photos on the following page show you how to set up the Modulponic units. The growing tube should be level so that the nutrient solution will be evenly distributed to the roots of the plant. My plants are fed four times a day; the timer is set for eight AM, 12 noon, three PM, and seven PM.

A flowing stream for watercress

"Do you like watercress?" Barry asked me one day when I was out



Aquarium pump (1), regulated by timer (2), pumps air into top of nutrient reservoir (3) via air hose (4). This forces nutrient solution into growing tube (5) through small connecting tubes (not shown). When timer turns off pump, nutrient drains back into reservoir, drawing air into growing medium to aerate roots. Sight gauge (6) shows nutrient level. To change nutrient, you slip top of sight gauge out of growing tube and let solution run out. You replace nutrient (and add water) by pouring into open top of growing tube. Second timer (7) regulates grow lights (8) on indoor unit.

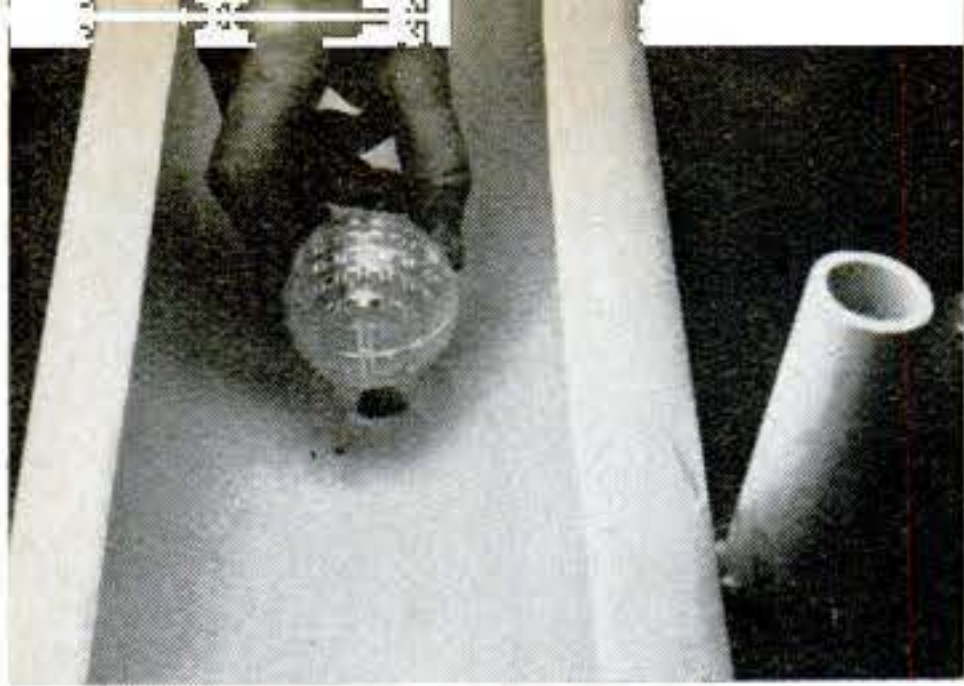
at the Homeland factory looking over its operation. "Love it," I replied with enthusiasm.

"Watercress will only grow in a flowing stream," Barry explained. So he designed a unit that circulates the nutrient solution constantly—a veritable babbling brook for your window sill. The watercress grower is a two-tier system, with a 12-by-26-inch growing bed nesting in a 12-by-28-inch nutrient reservoir. An aquarium pump constantly bubbles the nutrient solution up into the growing bed, where it percolates through the growing medium and drips back into the reservoir. This little watercress factory sells for \$50.

Care and feeding

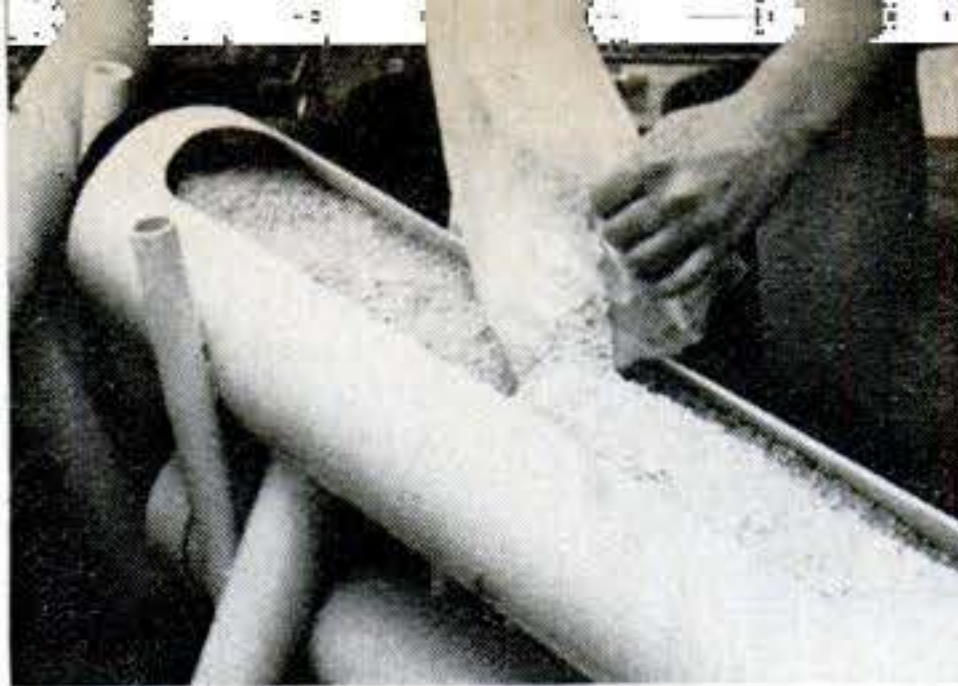
Surface evaporation and transpiration from the plants constantly deplete the water in the nutrient

Continued



How you set up the Modulponic units

1 Plastic filter keeps growing medium from falling into tubes that connect nutrient reservoir to growing bed. Filters should be covered with gravel.



2 Fill growing tube with perlite (expanded volcanic glass) growing medium to within one inch of top. If weight is not a concern, gravel can be used instead.



3 Moisten perlite thoroughly with plain water or nutrient solution. If water is used, mix extra-strength nutrient solution to finish filling reservoir.



4 When transplanting seedlings started in soil, wash roots well in room-temperature water. Hard-to-remove clumps of dirt will come off under running water.



5 Make hole in dampened perlite and place seedling's roots inside. Tamp perlite firmly around stem. Seedlings suffer no shock when transplanted.



6 Washed gravel an inch deep goes around seedlings, filling growing tube to top. If seeds are planted, sow them in gravel as you would in soil.

reservoir in a hydroponic system. How frequently you have to add makeup water depends on the size of the plants, speed of growth, temperature, and humidity. When my plants were small, I added water every three or four days. But by late summer when the plants were large and the days hot, I had to add water every day.

The nutrient solution should be changed every two weeks (every three weeks for the watercress unit). I use the old solution on my houseplants. Once a month, when you're changing the nutrient, you also flush the growing bed with plain water to wash out the fertilizer salts that tend to accumulate.

Once a year you clean out the Modulponic unit entirely: Pull out all the roots, discard the old perlite and gravel, and sterilize the PVC tubes with a solution of one tablespoon of chlorine bleach per gallon of water. After a thorough rinsing the unit is ready for use again.

That's all the care a hobbyist's hydroponic garden really requires. But there is one other step you can take to assure that your plants get the optimum nourishment.

About pH tests

If you read my March article on soilless gardens, you know that serious hydroponic gardeners regu-

larly test the pH (acid/alkaline balance) of the nutrient solution. The pH is critical because plants can't utilize available nutrients if the pH of the solution (or the soil in conventional gardening) is too far from the ideal. Most plants prefer a slightly acidic solution, around 6.5 (seven is neutral).

As with most hobby hydroponic kits, Homeland Industries' system does not include instructions for pH testing. It's not necessary, says Barry, because the nutrient concentrate is formulated to be fairly acidic, and practically all tap water is alkaline. So when nutrient and water are mixed, the solution should be within the acceptable range for most plants. Also, as the nutrient solution is recycled over the two-week period, it tends to wander toward alkalinity. So by starting with a fairly acidic mix, you avoid the danger of having an alkaline solution (which most plants can't tolerate) before it's time to change it.

Mostly out of curiosity, I bought a pH testing kit to see just what was happening in my system. Starting with water that tests at about 7.2 (somewhat alkaline), I end up with a nutrient solution with a pH slightly below 6.2 (the lowest my kit will show accurately). Even after two weeks, my solution seldom tests above 6.8.

While that range is probably acceptable, I've decided to try to keep the pH closer to the 6.5 ideal. So the last time I mixed a new batch, I added 1/2 teaspoon of baking soda, which brought the pH up to 6.5. When it gets above 6.5, I'll add a few drops of distilled white vinegar. Not enough time has passed to see if this will make any difference in the health and productivity of my plants, but it's fun to experiment.

Problem solving

One Saturday morning, I noticed a small puddle under the hydroponic unit on my terrace. I investigated and found that it had sprung a leak at a joint. I rubbed in some silicone caulk and the leak stopped.

My indoor unit had a different kind of problem. Even though the nutrient reservoir was filled to the proper level, the solution would only come up about three-quarters of the way in the growing tube at feeding time. After a bit of detective work, I found the culprit: At the factory, a small hole is made in the air hose near where it connects to the aquarium pump. The hole lets a little air escape and assures that the nutrient can drain back into its reservoir after the pump shuts off. But the hole was too big, so not enough pressure was avail-

[Continued on page 168]

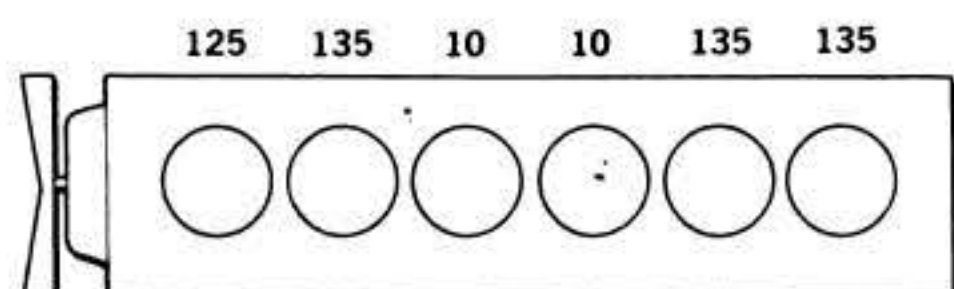


Car-care quiz

Second in a series prepared for PS by NIASE (an independent, nonprofit corporation that tests and certifies mechanics), through the courtesy of the Car Care Council. For a free listing of garages in your state that employ certified mechanics, send a stamped self-addressed envelope to NIASE, 1825 K St. NW, Washington, D.C. 20006. For a national listing, send \$1.95.

1 Mechanic A says the compression readings below may be caused by a blown head gasket. Mechanic B says they may be caused by wrong valve timing. Who's right?

- (A) A only
- (B) B only
- (C) Both A and B
- (D) Neither A nor B

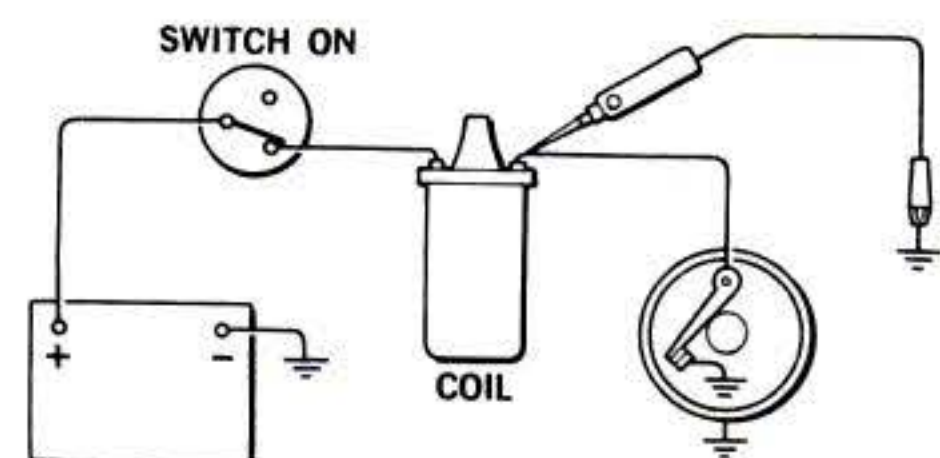


2 A driver says the front end of his car vibrates up and down while traveling at most road speeds. Mechanic A says that too much runout of the front tires could be the cause. Mechanic B says static out-of-balance of the front tires could cause it. Who's right?

- (A) A only
- (B) B only
- (C) Both A and B
- (D) Neither A nor B

3 What is the state of charge of a battery that has a specific gravity of 1.200 at 80° F (25° C)?

- (A) Completely discharged
- (B) About 1/2 charged
- (C) About 3/4 charged
- (D) Fully charged



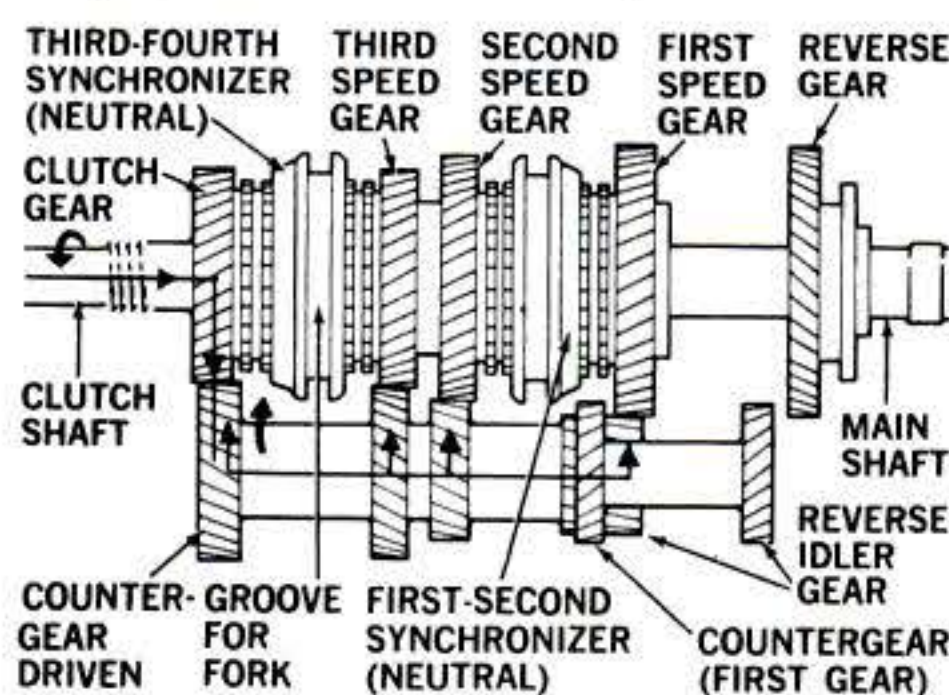
4 The test light in the above diagram doesn't light while the engine is cranking. Mechanic A says this could be due to the points not opening. Mechanic B says it could be due to a grounded distributor wire. Who is right?

- (A) A only
- (B) B only

- (C) Both A and B
- (D) Neither A nor B

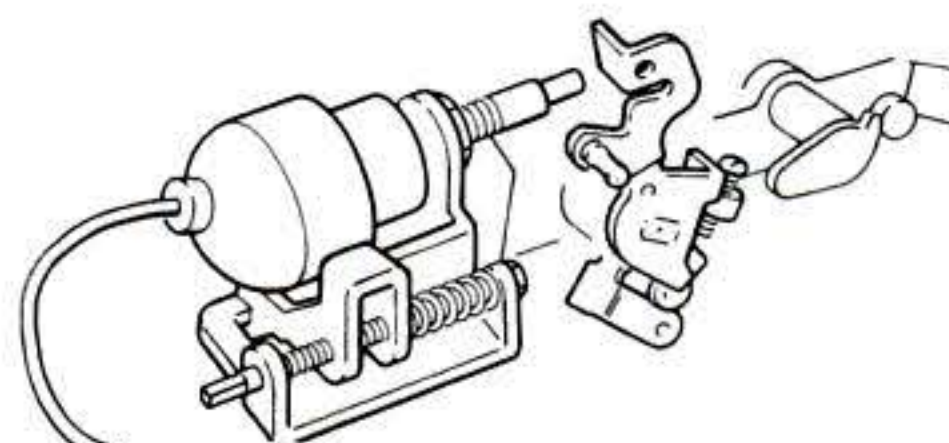
5 With the automatic-transmission pan removed, the best way to pinpoint an oil-pressure leak is to:

- (A) Check the filter pick-up tube seal
- (B) Check line pressure
- (C) Inspect the valve body
- (D) Perform an air-pressure test



6 In the four-speed, fully synchronized transmission above, there is a clunking or knocking noise in only first and reverse. Mechanic A says that it's a broken tooth on the clutch (input) gear. Mechanic B says that a broken tooth on the counter (cluster) gear could be the cause. Who is right?

- (A) A only
- (B) B only
- (C) Both A and B
- (D) Neither A nor B



7 All of these statements are true about the device above, *except*:

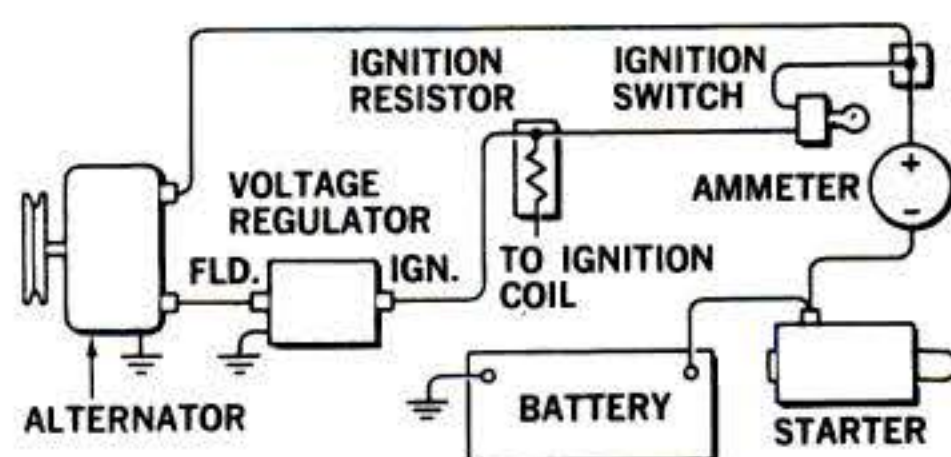
- (A) It controls engine idle speed
- (B) It can cause dieseling (after-run) if not adjusted right
- (C) It opens the carburetor throttle plates when ignition is on
- (D) It controls engine fast idle during warm-up

8 A mechanic completes a disc-brake overhaul. He attaches a pressure bleeder, which is pressurized to about 25 psi, to the master cylinder. He cannot get any fluid to come out of the disc-brake caliper bleeder screws. Which of these is the most likely cause?

- (A) A bad proportioning valve
- (B) A bad pressure-differential valve
- (C) The proportioning-valve release button is not activated
- (D) The metering-valve release button is not activated

9 There is a growling or rumbling noise at the air-conditioning compressor when the system is off and the engine is running. The noise stops when the system is turned on. Mechanic A says that a bad compressor-clutch bearing could be the cause. Mechanic B says that it could be a bad compressor bearing. Who is right?

- (A) A only
- (B) B only
- (C) Both A and B
- (D) Neither A nor B



10 The charging system shown above was *not* charging until a jumper wire was connected between the B (battery) and F (field) terminals of the alternator. Mechanic A says a bad stator winding could be the cause. Mechanic B says an open circuit between the ignition switch and voltage regulator may cause it. Who's right?

- (A) A only
- (B) B only
- (C) Both A and B
- (D) Neither A nor B

Answers begin on page 178

'78 string trimmers

—better and
less expensive



New features make these handy weed choppers a better value than ever before

By A. J. HAND

1978 may be the best year ever to shop for string trimmers—those little weed choppers that use a heavy nylon monofilament instead of a blade. Right now, the market is crowded with well over a dozen makers—all fighting for your business. This competition has kept prices down to last year's levels while increasing the number of attractive new features. For example:

- Automatic line feed. This lets you avoid stopping the motor each time you need fresh cutting line. For some users, Black and Decker's model 8207 might have the most convenient line feed. As the cutting line wears off, fresh line advances immediately and automatically.

But if you plan on trimming close to prized flower beds, you may want some control over the timing of string advance. With fully automatic feeds, you run the risk of having a fresh length of string whip out unexpectedly, destroying flowers as well as weeds. The new tap-advance system gives you more control. To advance fresh line, you simply tap the trimmer against the ground. This releases spring tension on the line spool and allows it to feed. Selected models from Sears, Toro, Weed Eater, K&S, and Allegretti

Homelite's little gas-powered trimmer weighs only seven pounds, but cuts a 20-inch-wide path. Its 26-cc, 1.5-hp engine runs 45 minutes on one pint of gas.



Toro's cordless electric trimmer (far left) has tap-advance line feed, cuts a seven-inch swath, and weighs seven pounds. True Temper's cordless (left) is a light-duty tool powered by a six-volt rechargeable battery.



offer the tap-advance feature.

Another form of automatic line advance is the handlebar-mounted trigger that you squeeze as you cut to advance fresh line. It's available on gasoline-powered trimmers from Weed Eater and Advanced Engine.

Finally, Homelite's new gas-powered string trimmer has a unique "Idle-Line" string advance. When the string gets too short, the advance system automatically feeds another length of string into the guard, but the filament doesn't advance for cutting until you release the throttle, letting the engine idle.

- **Cordless electrics.** These are increasingly popular. True Temper offers two; Sears and McGraw-Edison each offer one; Toro's has tap-advance line feed; and Black & Decker has one with optional nylon blades to handle heavier grass. Typical running time is 45 minutes from an overnight charge.

- **Extra power.** Sunbeam calls it "Burst of Power," Sears call it "Power Surge," and Allegretti calls it "Torque Booster." Call it what you like, it's a two-stage switch that gives you an extra shot of power for whipping your way through heavy growth. When you need less torque, you can switch down to ease the load on the motor.

- **Small gasoline trimmers.** These provide the go-anywhere convenience of cordless electrics, but have much more power to handle the heavy trimming jobs. Echo, Sears, Toro, John Deere, K&S, Weed Eater, Homelite, and Advanced Engine all sell them. Most models have automatic line feed, and some (including the Echo 140D and the Weed Eater 698) can take blades to mow down heavy

Garden Pro's 806V2 (right) features a unique, detachable tripod that turns the trimmer into a light-duty lawn mower. The unit isn't suitable for mowing a large lawn, but it is a light and maneuverable alternative for working tight spots.



Weed Eater's 12-pound Model 608 features auto line feed. It cuts a big 17-inch circle around hard-to-trim poles.

growth much faster than nylon line can. Advanced Engine offers three different weights of cutting line for their Groomers; you can switch them in seconds without tools.

- **Prices.** You can get a light-duty electric string trimmer for just \$20; top-of-the-line electrics cost about \$90. Small gas trimmers—those with engines around 22 cc—start at about \$150, but most gas models are priced at over \$200. You can go as high as \$450 for some models. [S]

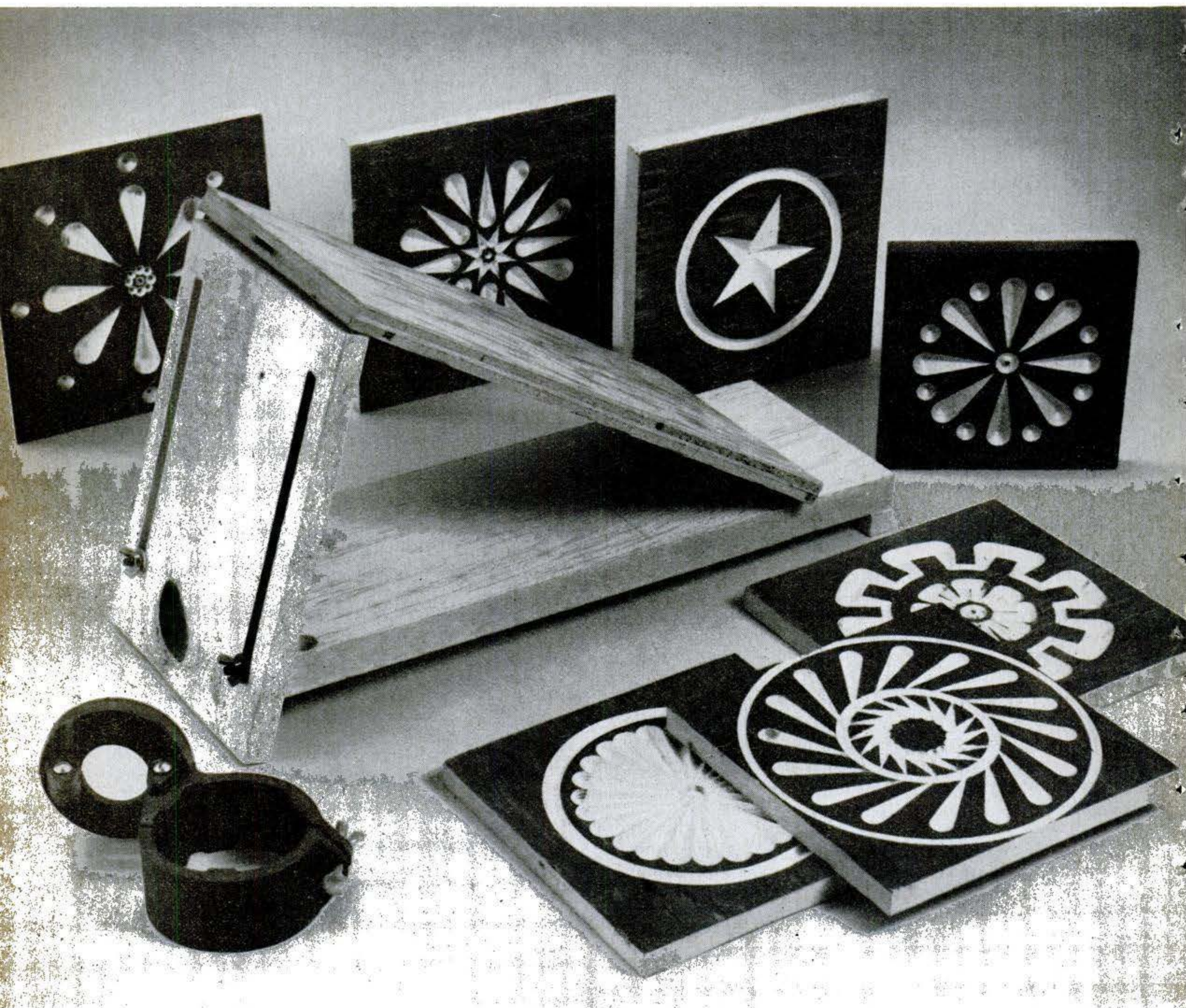
MANUFACTURERS LIST

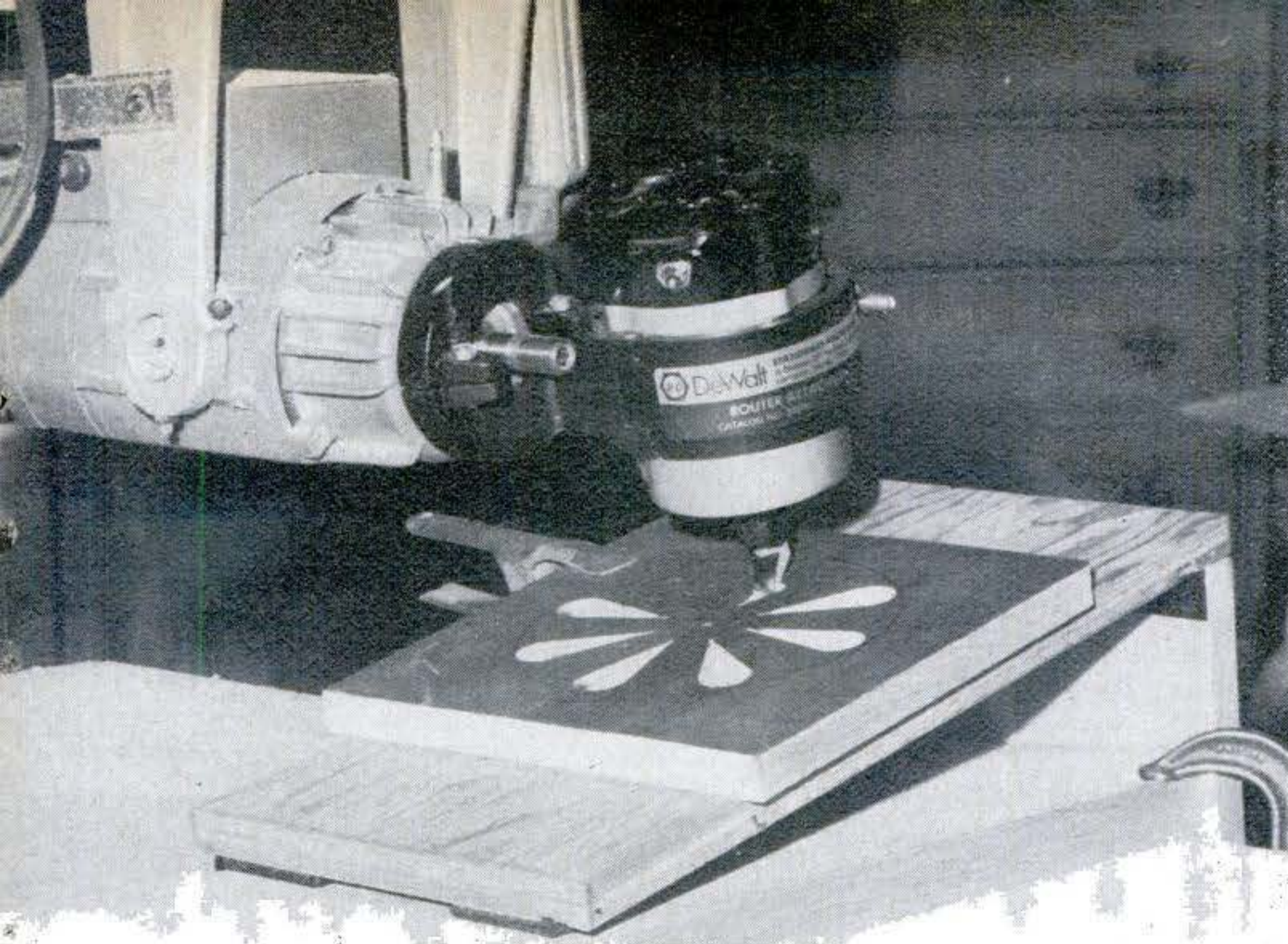
Advanced Engine Products, Inc., 7525 Mitchell

Rd., Eden Prairie MN 55343; **Allegretti & Co.**, 9200 Mason Ave., Chatsworth CA 91311; **Beaird-Poulan Div., Emerson Electric Co.**, Shreveport LA 71107; **Black & Decker Mfg. Co.**, Towson MD 21204; **Echo Chain Saw Div.**, Northbrook IL 60062; **Garden Pro, Inc.**, 2655 Villa Creek Dr., Dallas TX 75234; **HMC**, 22133 S. Vermont, Torrance CA 90502; **Hoffco, Inc.**, 358 Northwest F, Richmond IN 47374; **Homelite**, Box 7047, Charlotte NC 28217; **K & S Industries, Inc.**, Box 612, Ft. Worth TX 76101; **Maddox Co.**, 102 Forestview Dr., Dayton OH 45459; **McGraw-Edison Co., Portable Tool Group**, 1801 N. Stadium Blvd., Columbia MO 65201; **Sears, Roebuck & Co.**, Sears Tower, Chicago IL 60684; **Stihl, Inc.**, 5701 Thurston Ave., Virginia Beach VA 23455; **Sunbeam Corp.**, 900 Jorrie Blvd., Oak Brook IL 60521; **Toro Co.**, 8111 Lyndale Ave. South, Minneapolis MN 55420; **True Temper Corp.**, 1623 Euclid Ave., Cleveland OH 44115; **Weed Eater Inc.**, Box 42334, Houston TX 77042.

Radial-arm router

lets you cut
fancy wood designs





Slanting wood panel causes groove to widen and deepen (left) as tapered router bit moves away from center pivot point. C-clamp holds jig on table.



For precision control, yoke your router to a radial-arm head. Build a jig for taper carving

By **HOWARD SILKEN**

If you own a portable router [PS, March] and a radial-arm saw, a special clamp that yokes your router to the saw head will convert the combination into a radial-arm router. This combo gives you far greater precision than a hand-held router. With it, you can perform every operation an expensive overhead router will do—plus a few tricks that overheads can't.

The metal attachment, manufactured by HIT Products, Inc. (P.O. Box 6906, Hollywood, Fla. 33021), is also available at any Black & Decker DeWalt service center or dealership for about \$32. You can attach almost any router body to the 10- or 12-inch radial-arm saws manufactured by DeWalt (Black & Decker), Sears, or Delta (Rockwell). I've been using this attachment for several years and recently designed a simple jig that makes it easy to create fancy shapes and designs. (If you prefer, you can devise your own wooden yoke attachment, as shown in the box.)

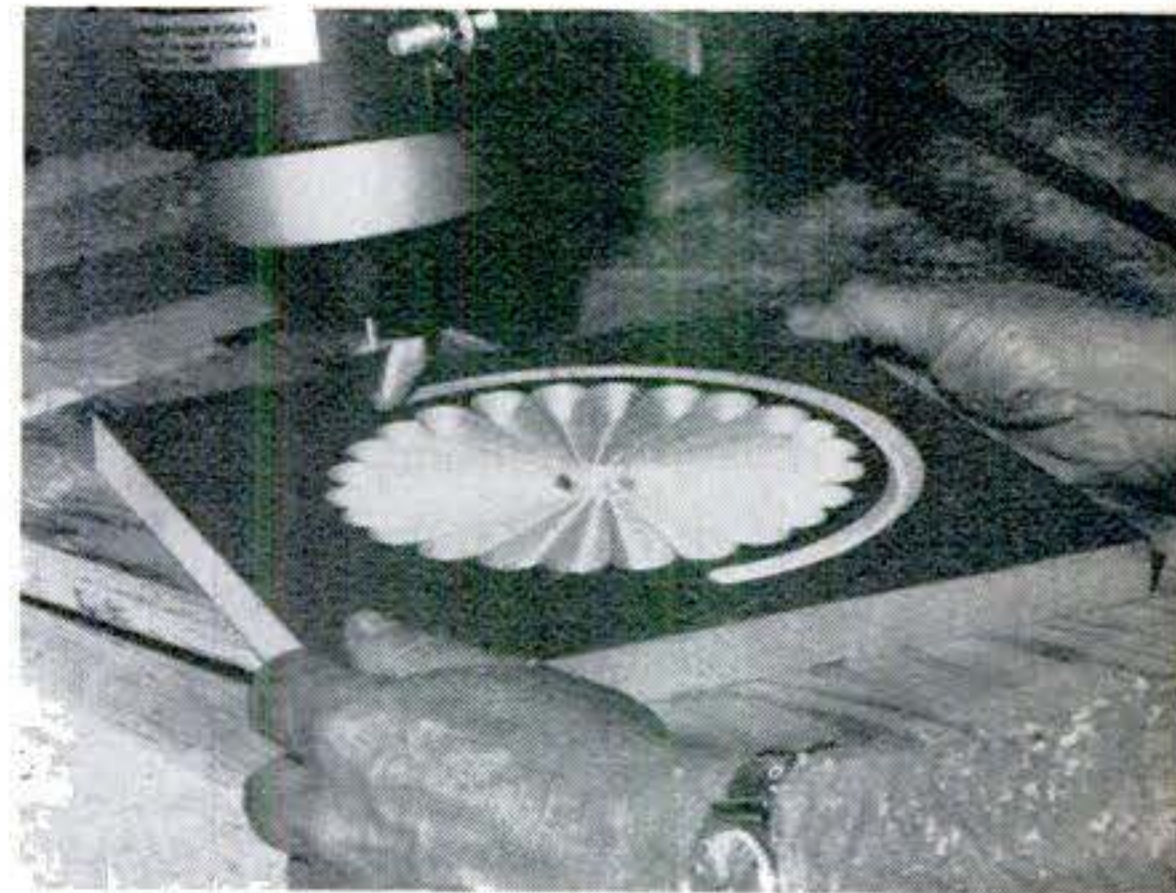
What makes these designs unique is their three-dimensional effect. Certain router bits (V-groove, core box, and pilotless "OG") have

the characteristic of cutting a wider groove as depth is increased. Normally, it is very difficult to change cut depth while operating a router.

To solve this problem, the work piece can be held at a slight slant on a jig and the router pulled forward into the work. As you advance, the router bit cuts deeper and thus wider. You end up with a teardrop-shaped cut.

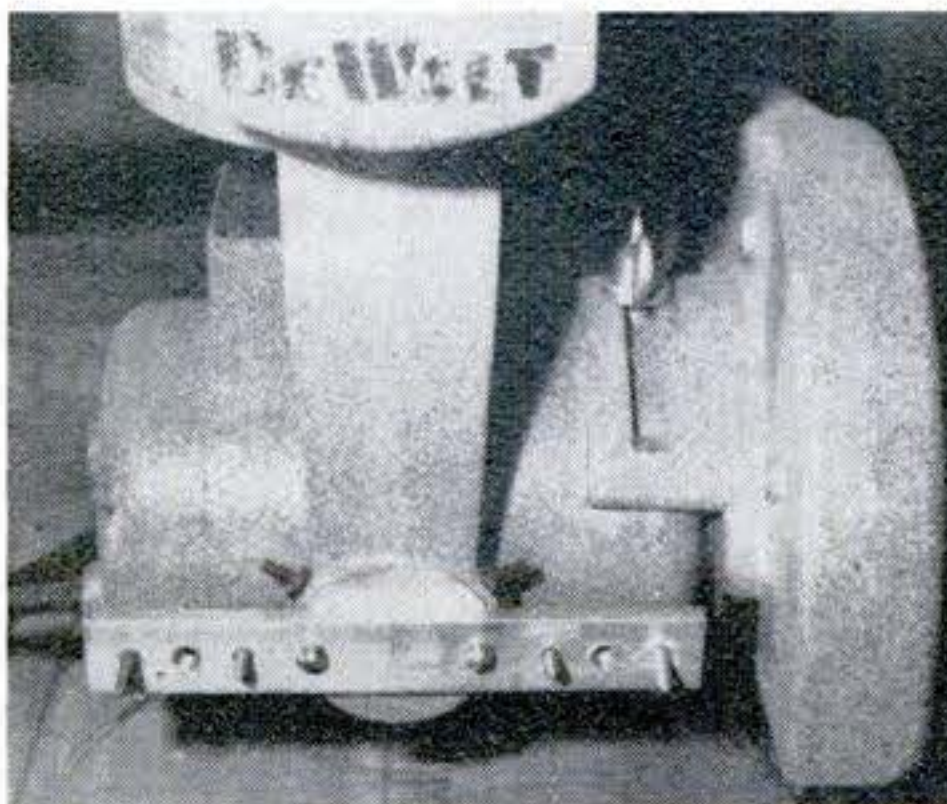
If you use a V-groove bit, you will rout a pointed bottom in the cut. Use a core-box bit and the bottom will be round. Adjust the jig at a slight angle and you'll cut a long, slender teardrop. Increase the angle and the teardrop becomes

Continued

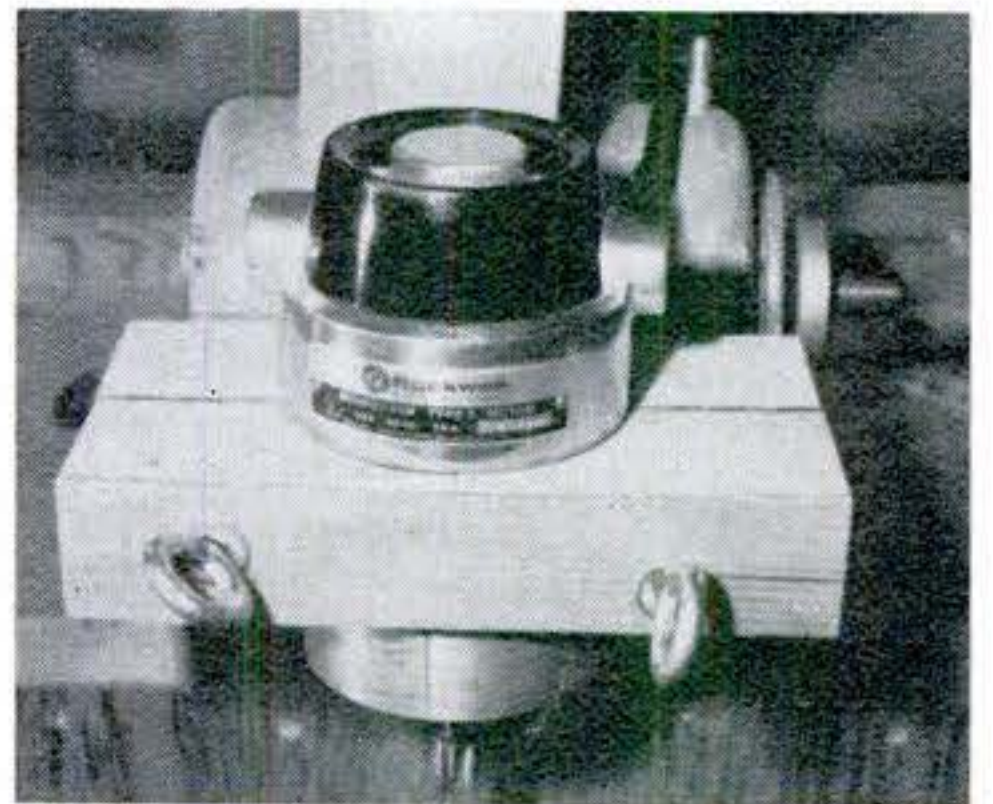


Sunburst design is cut (top) using 24 router passes. Above, the decorative design is completed by routing a circle around the sunburst carving.

How you can make your own yoke



You can make a simple router yoke from wood sized to fit your radial-arm saw. To attach my yoke, I drilled a 7" length of 1/4"-by-1" aluminum bar stock. The bar mounts on the dust cover (as shown in left photo) with longer bolts to replace the originals. The second hole from each end of the bar is tapped for long 1/4" eye bolts that serve as clamping screws. (I pass a screwdriver through the eyes for tightening.) The four holes that flank the eye-bolt holes are for screws into the



stationary block (removed here for clarity). For the blocks, I clamped two 2-by-4's together and drilled on the joint with an expansion bit set to the router's body diameter. I trimmed 1/8" from the mating faces to provide a clamping gap and also trimmed the rear face of the stationary block to snug the router closer to the saw head. I drilled two holes near the center to let me drive the mounting bolts with the bar screwed to the block.—Roy C. King

Decorative panels cut by author surround the home-built jig used to slant wood as it is cut to varying depths. Metal clamp at left is used to attach routers to various radial-arm saws.

shorter and stubbier. To achieve this variety, it is best to work with an adjustable jig (see box below).

Carving a design is simple. First drill a small hole (the size of the pivot point) in the center of the piece to be routed. With a compass, scribe a circle the size of the design. Mark off this circle with the number of points you wish to carve.

Draw lines through these points and the center point. Bring these lines all the way out to the edges of the piece. You align these marks with the upper guideline on the

slant-table board to index the piece. Position the entire jig so the bottom of the bit is directly over the pivot point.

Then clamp the jig onto the work table of your saw by grabbing the "false-fence" cleat between the back boards and your work table. Use a C-clamp to secure the other end of the jig to the front of your saw table. Set the slant table at a shallow angle. Place the work piece on the slant table with the pivot point in the center hole.

Adjust the router adapter so it holds the router motor at about the

same angle as the slant table. (It does not have to be exact.) Locate any line on the work piece with the guideline on the slant table, and then clamp the work piece to the slant table. I use a strong spring clamp for this—two (one at each side) do an even better job.

Push the roller head back so the router bit is directly over the circle you scribed. Now lower the router motor until the bit is just above the surface of the work piece. Turn the router on and pull it forward, carving the teardrop.

When you have carved it as far as you wish, turn off the router motor.

Sunbursts and clamshells

Starting the cut on the outside scribed circle will make the teardrop larger as you cut toward the center. This creates stars and sunbursts. Starting your cut at or near the center causes the teardrop to widen near its outer edge. This cut is suitable for floral and clamshell designs.

If you miter the arm to the right or left or if you move the jig so the center point is to the right or left of the bit, you can get a pinwheel effect. Dots can be made by lowering the bit into the work at some or all of the index lines. Circles can be cut by lowering the bit into the work and then rotating the work on the pivot point. When making dots or circles, be sure to lock the roller head on the arm with the rip lock.

Teardrop cuts are not restricted to work around a pivot point. You can attach a straightedge to the slant board and make repetitive designs on straight boards for special-effect picture-frame moldings.

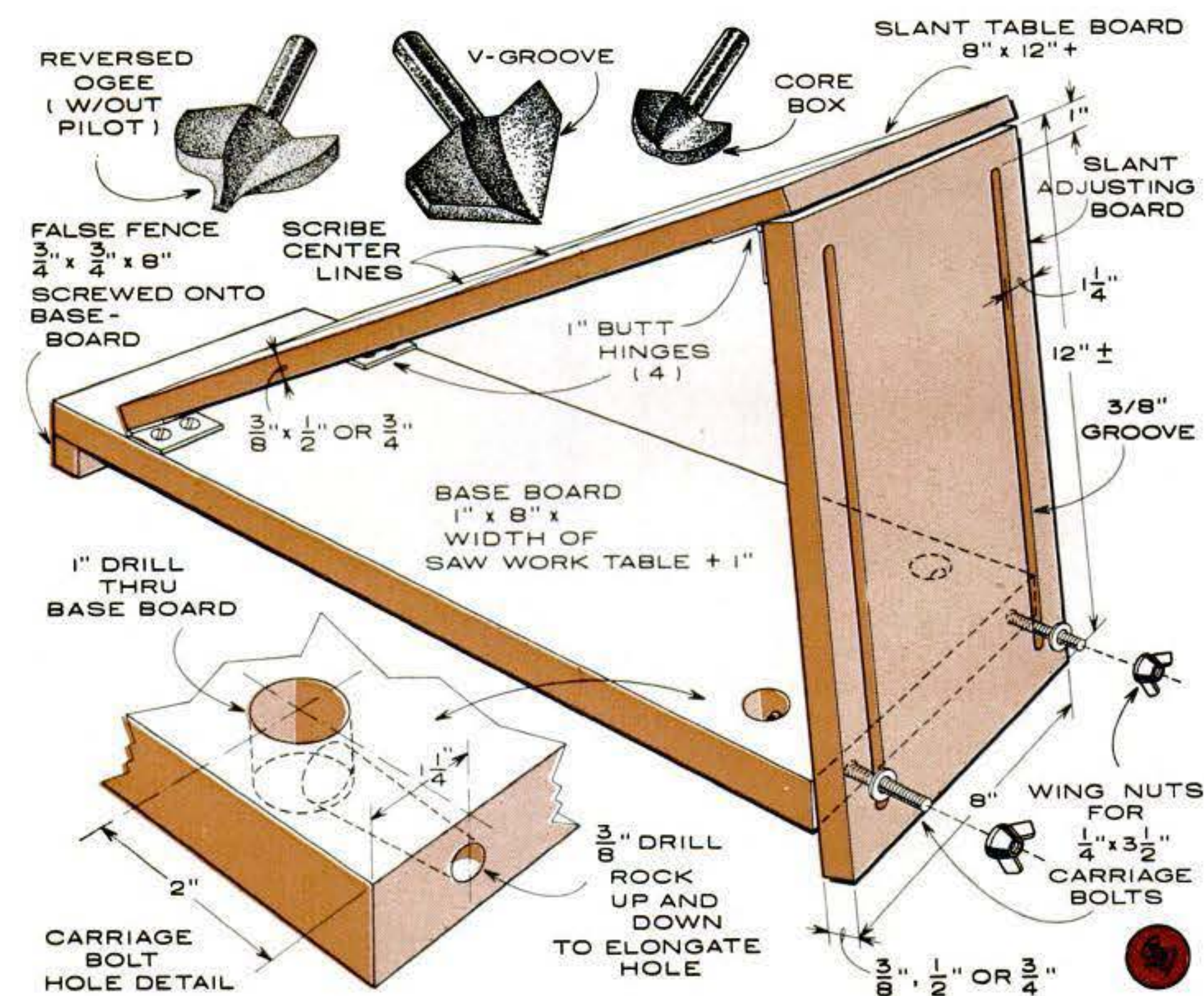
Fancy cuts and special designs are just some of the many uses to which you can put your router adapter. Besides using it as an overhead router, you can set it in a horizontal position. Then, with the use of an elevating table, it can be used to make mortises, dovetails, slots, grooves, and a few operations I haven't thought of yet.

The adapter that Black & Decker sells fits DeWalt (9-, 10-, and 12-inch) and Delta (9- and 10-inch) saws. It will hold most of the Black & Decker, Rockwell, and Sears router motors. If you have a router with a smaller- or larger-diameter motor than those mentioned, the adapter can be altered by HIT Products to accommodate it. Just send them the make and model number of your router or its motor diameter and they will supply you with the right adapter.

Build a jig for smooth taper carving

You can build the jig from scrap wood—plywood, particle board, lumber, or a combination. Make sure, however, that the base board and slant table are flat. I suggest a base piece of pine or fir at least a full inch thick. For the slant table use $\frac{3}{4}$ " plywood. Any piece of lumber will do for the slotted adjusting board. The base piece should be at least 8" wide and 1" longer than the width of the work table of your saw (measured from the fence to the front of the table). The jig is positioned on the saw table by a $\frac{3}{4}$ "-by- $\frac{3}{4}$ " cleat the width of the base board. This piece (called a false fence) is secured across one end of the base board with either screws or glue and nails. The opposite end of the base board has two 1" holes drilled through it, centered about $1\frac{1}{4}$ " from the sides. Two $\frac{3}{8}$ " holes are drilled through the end of the base board to meet the center of the 1" top hole. After you have drilled these meeting holes, rock the drill up and down to elongate the holes. This will provide clearance to slip a carriage bolt

($\frac{1}{4}$ " by $3\frac{1}{2}$ ") through the end holes with the head inside the 1" top hole. The slant-table adjusting board should be the same width as the base board and about 12" long. It can be of $\frac{1}{2}$ "-, $\frac{3}{8}$ "-, or $\frac{3}{4}$ "-thick material. Two $\frac{3}{8}$ " grooves are routed through the board to about 1" from either end. If you wish, make the slant-table board wider than the base and slotted board. It can be shorter than the base board or of equal length, but it cannot be longer. The slant-table board has a pivot point in its exact center. Locate this point with two dark cross marks drawn 90° to the edges. These lines will be useful guides for locating and indexing the piece of wood being routed. Make the pivot point out of a copper carpet tack or small aluminum nail; these materials won't harm the router bit if it should go deep enough to strike the pivot point. All three pieces of the jig are assembled with four small hinges or two piano hinges. The angle of the slant table board is locked with wing nuts and washers on the carriage bolts.



End kitchen clutter

with space-saving
built-ins

Consolidate the little appliances, then build in the big ones. Here's how

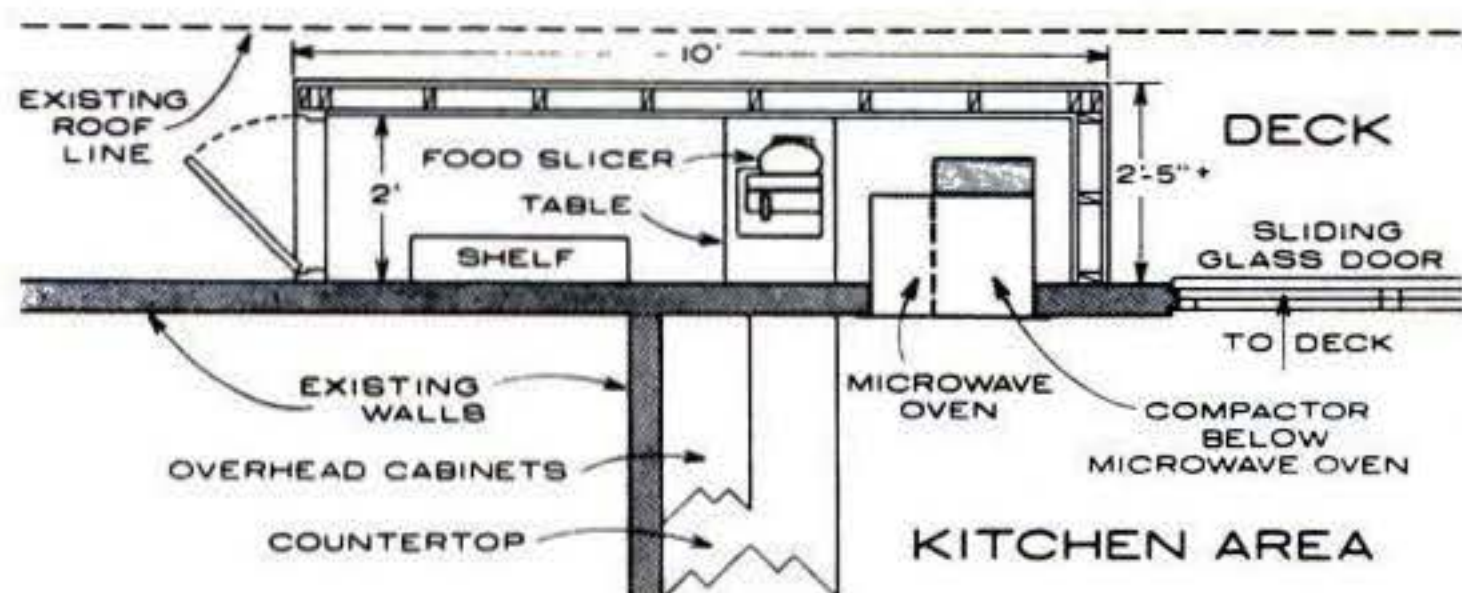
By EVAN POWELL

"Compact and convenient" is how I described our new kitchen three years ago. Our countertops provided plenty of work room. But an ever-growing array of small and large appliances gradually ate up all that space. One countertop turned into a snake's den of cords. Another was sacrificed when we purchased a commercial food slicer. Then a compactor was squeezed in, blocking three drawers.

Finally, when a microwave oven took over what was left of the counter, I knew I had to act.

Continued

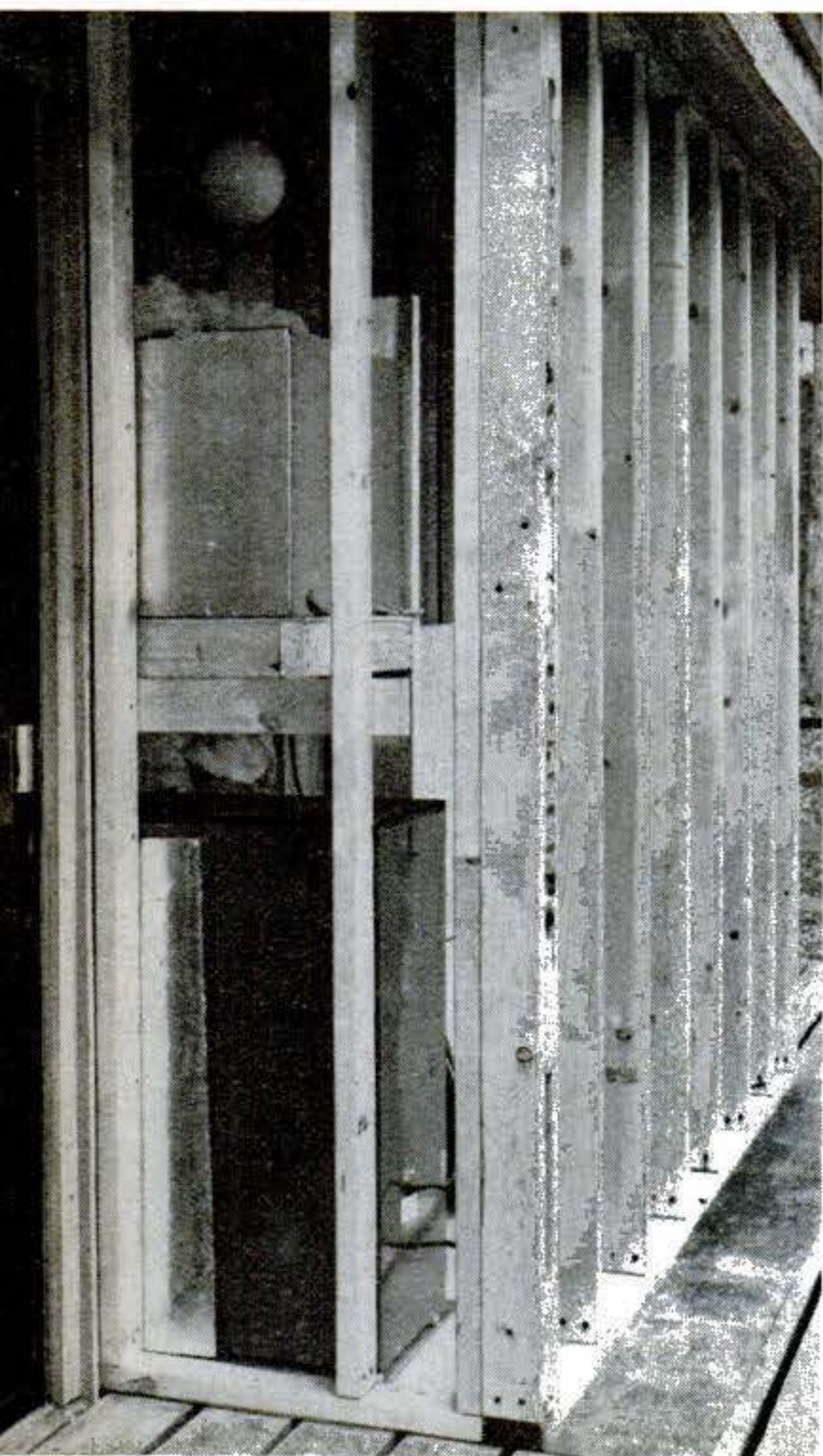
Before: A jumble of appliances had taken over the counters of this cluttered kitchen (right) while the compactor at far right impeded access to storage drawers. An all-purpose addition beyond outside wall to right (diagram below) permitted recessing large units into new space. In uncluttered kitchen (bottom photo) the built-in compactor and microwave oven are out of the way, yet easily accessible (each pulls forward for servicing). The sleek NuTone power unit next to the blender has replaced the clutter of small appliances. When not in use, the blender is stored below with the unit's other lightweight accessories.





Simple, galvanized steel sleeve is the build-in kit for the Amana oven. The range slides in on bottom rails and locks in place. Air-vent grilles (not shown) snap into sleeve.

To prepare wall, carefully make shallow cuts just large enough to insert appliances. If accurately done, no wallboard patching or replacement is needed. The cuts in outside wall don't have to be as precise. Wiring may have to be rerouted (always turn off power before cutting into wall) and framing removed. Load-bearing walls can be resupported from the outside.



To keep wall thickness to a minimum, thin but strong Thermo-ply insulative sheathing was used. Let-in corner bracing isn't needed for this small addition.

For easy maneuvering, appliances were installed before addition was enclosed. Compactor stands below oven sleeve, which sits on support frame.

As I pondered the problem, some related ideas began to jell. There were three possibilities:

- Build in the large appliances.
- Consolidate the small ones (see box).
- Add extra space.

I decided to do all three. But we couldn't spare any cabinet space to build in the compactor or microwave oven, nor was it possible to expand into an adjacent room. The only way to go was out, but I wanted to avoid a major renovation—knocking down a load-bearing wall or tying into the roof system.

By adding a small bay to the outside of the house, I could both build in the large appliances and make extra space for the odds and ends (including the bulky food slicer). This skinny, all-purpose room snugs up against the exterior wall, using an existing deck as its floor and the 36-inch roof overhang as its roof.

The same basic concept could work with many other houses. If you have no deck, you can lay a simple foundation. If your roof overhang is not wide enough to shelter the appliances, you can flash

Continued

you Get

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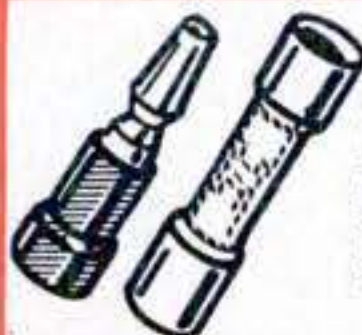
96 RING TERMINALS

For permanent connections. #6, #8 and #10. For 22-18, 16-14 and 12-10 wire gauges.



27 IN-LINE BUTT CONNECTORS

Splices for joining wires without soldering or taping. For 22-18, 16-14 and 12-10 wire gauges.



11 BULLETS & RECEPTACLES

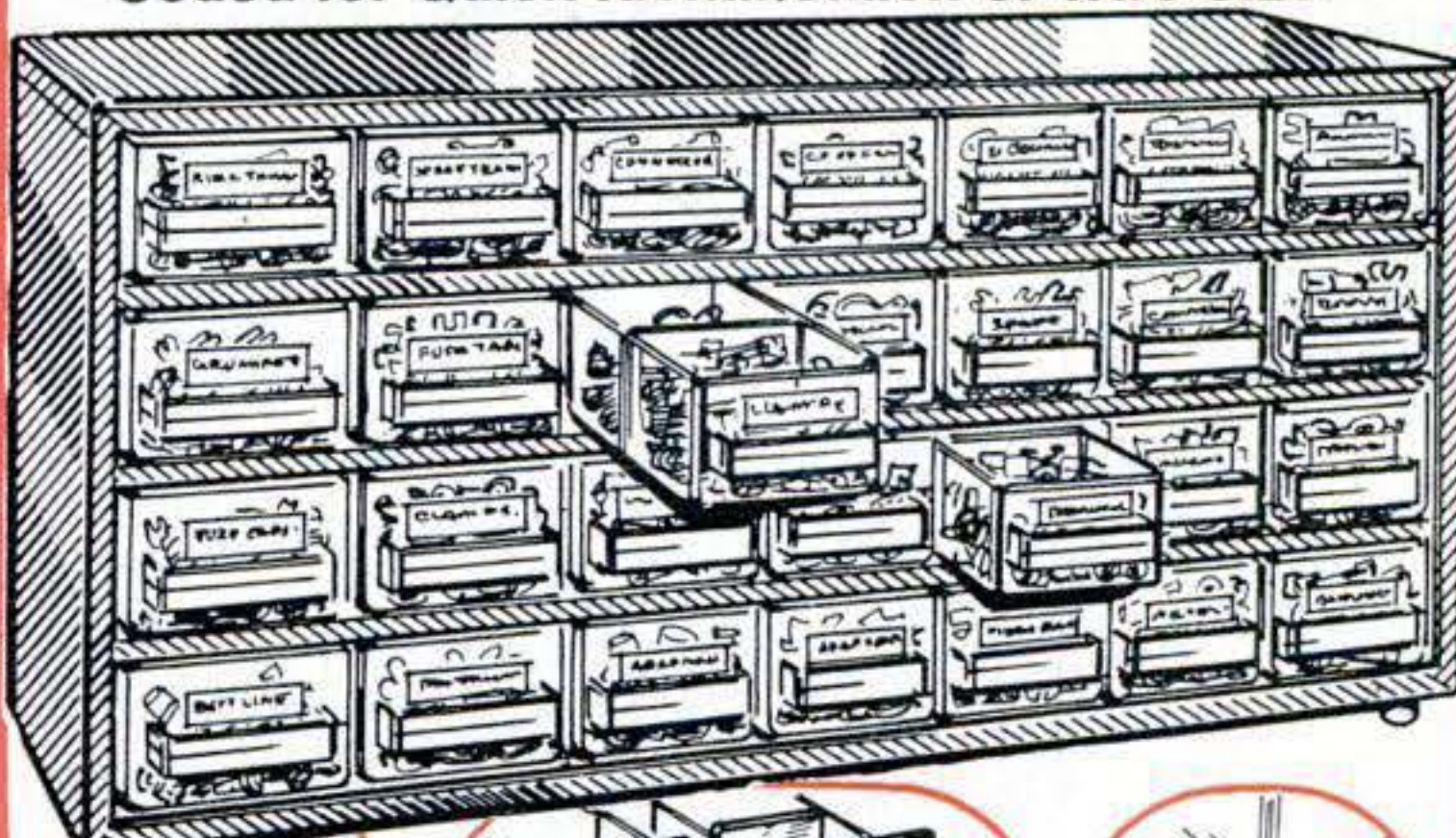
6 .157" bullets, 3 .157" fully insulated bullets, 2 .157" double receptacles.



6 CONNECTORS

.157". 3 bullets, 3 receptacles.

All Pre-Insulated Terminals are Color-Coded for Quick Identification of Wire Size



Mar-proof feet protect surfaces

28 drawers, 40 dividers—up to 68 compartments

Pre-printed drawer labels for instant identification



59 SPADE TERMINALS

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10 PIGGYBACK ADAPTERS

.250". Split one wire into two.



30 HI-TEMPERATURE TERMINALS

For household use. Withstand 900°F. temperature. Nickel plated steel (non-insulated). For refrigerators, stoves (heat exchangers, motor grounding lugs), anyplace with excessive temperatures. #10 ring, 1/4" ring, .250" female and .250" female flag for 16-14 gauge wire.



26 GROMMETS

Assure professional installation of wires through metal panels. Prevent vibration, wire damage, shorts. 10 1/4" hole diam., 1/8" I.D.; 8 5/16" hole diam., 3/16" I.D.; 8 3/8" hole diam., 1/4" I.D.



20 CABLE TIES

For easy, neat tying of all wire bundles. 10 5-1/2" long (1-1/4" bundle diam.), 10 3-1/2" long (3/4" bundle diam.).



52 MALE and FEMALE DISCONNECTS

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6 TEST CLIPS

4, 1" long for miniature electronics; 2, 2" long screw type.



6 RUBBER INSULATED METAL CLAMPS

For extra-heavy-duty jobs. 3/8" and 1/2" diam.



10 FUSE TAPS

.250". Allow quick take-offs from auto fuse blocks for adding accessories.



10 QUICK-SPLICE and TAPS

Take off an extra hot line quickly, without stripping wires. Fast hook-up for auto radios, CB's, trailer lights. Also for house wiring. For 22-18, 16-14 and 12-10 wire gauges.



30 NYLON CABLE CLAMPS

Safely mount wires and wire bundles away from excessive heat and moving parts. 1/8", 1/4" and 3/8" diam.



20 FLAG CONNECTORS

10 .250" tab, 10 .187" tab.



8 NYLON COUPLERS

Full-cover insulation. .250" tab width. For quick-disconnection of electrical accessories, CB's, stereos. Ideal for switch-back tab mounts, 4 styles. For 22-18 and 16-14 wire gauges.



16 CLOSED-END PIGTAILS

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- ALL TERMINALS PRE-INSULATED. PLUS—a group of special hi-temperature terminals
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Big wall chart shows and explains how and where to use the different types of wiring terminals and fasteners. Step-by-step illustrated instructions let you do a fast, professional wiring job every time. Yours FREE, when you order this Giant Professional Terminal Center.

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502 pieces include 74 different types of wiring terminals, devices and fasteners for every job—PLUS all-steel, 28 drawer, 68 compartment cabinet with pre-printed drawer labels and organizing chart and FREE illustrated wall chart with step-by-step instructions for proper use of the various types of terminals.

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- Pre-printed drawer labels and filing system give you the right connector instantly
- Mar-proof cabinet feet protect surfaces

All-Steel Cabinet has 28 see-thru, 5 1/2" x 2" x 1 3/4" sturdy plastic drawers with easy-pulls and stops. 40 drawer-dividers fit grooves in drawers to make up to 68 separate compartments. Pre-printed self-adhesive drawer labels instantly identify the contents of every drawer. Cabinet is 15" wide x 5 3/4" deep x 7 1/2" high with plenty of extra space for organizing all of your own small electrical parts. Heavy gauge steel cabinet with strong full steel shelves has a finish that won't chip, peel or wear off. 4 mar-proof feet prevent scratching of surfaces. Indentations on top corners let you stack 2 or more cabinets. Or slots in back let you hang it on the wall.

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Charge your order on your BankAmericard, Visa or Master Charge by filling in your card number:



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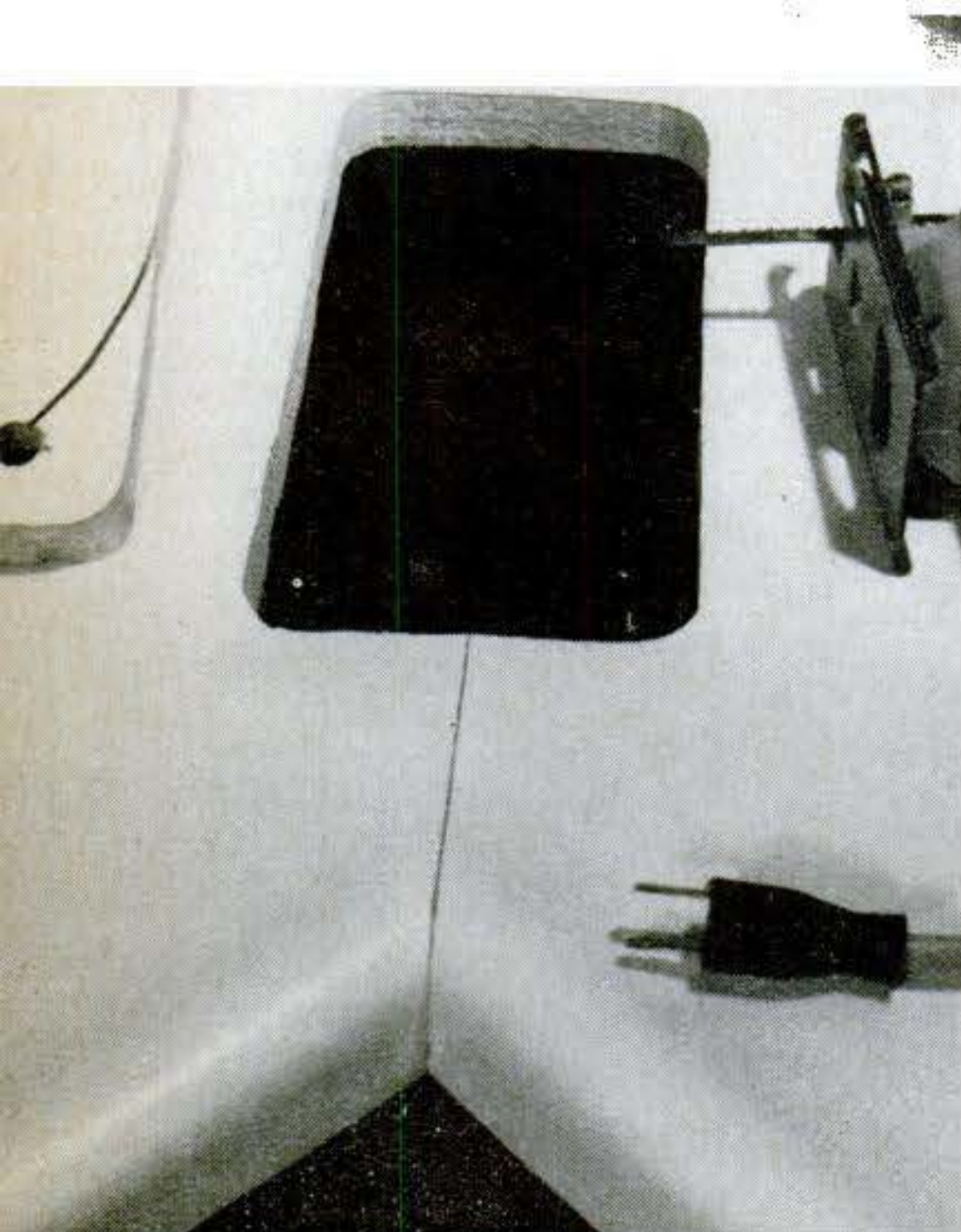
ADDRESS

CITY

STATE ZIP

End kitchen clutter

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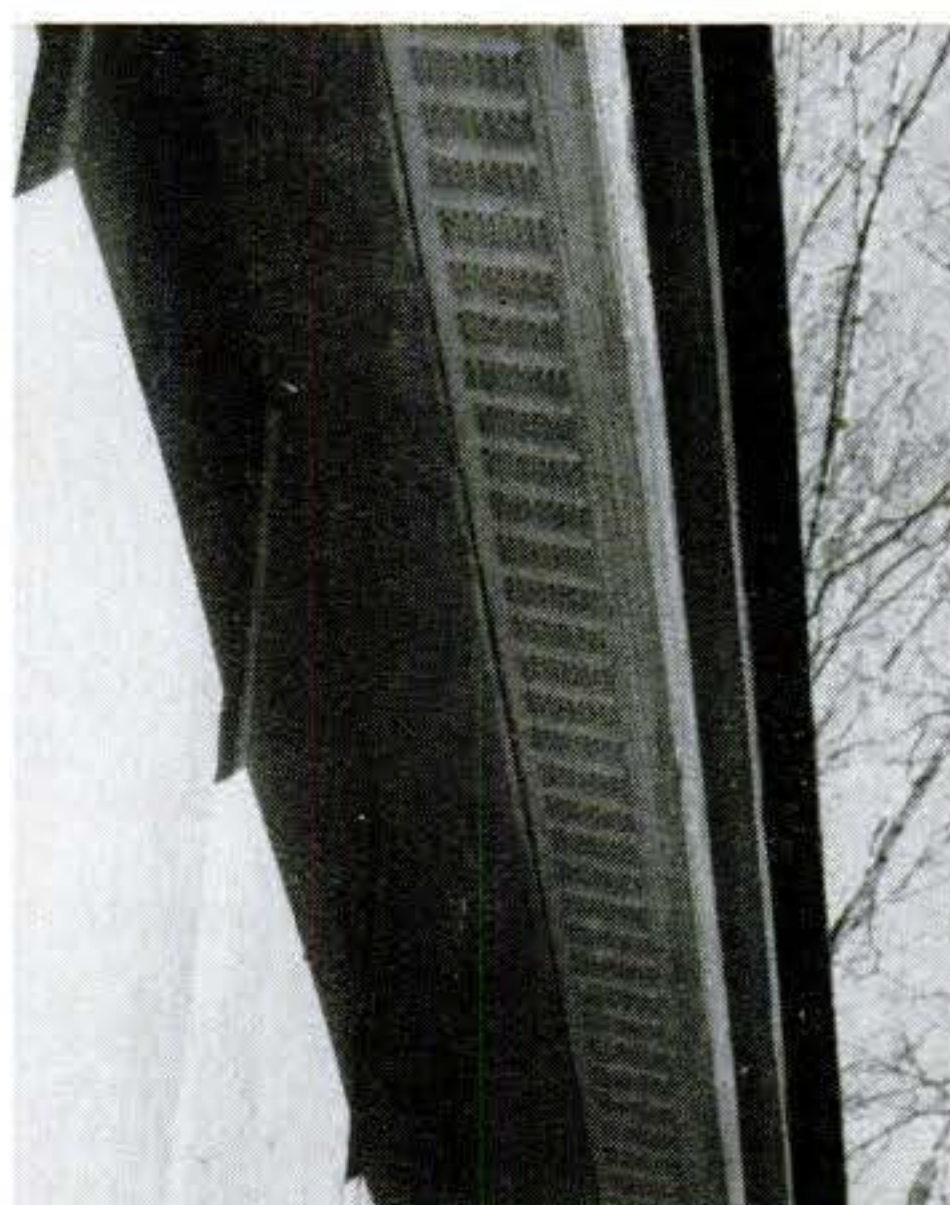
A fast saber-saw cut opens a counter-top hole for the NuTone Food Center power unit. It operates a variety of space-saving, cordless appliances.



Cabinet-matching wood panel replaces compactor's metal one. As with many appliances, the original panel was easily removed by unscrewing its top cap.

in a shed roof below it. [For details on these jobs, see "House Splicing," PS, April '77.] You can also build in major appliances without adding a bay—simply cut into the side wall of an existing closet or pantry. In either case, the project is fairly simple, as our photos show.

I erected the framing first. I laid the toe plate, assembled the top



When attaching siding, avoid blocking roof ventilation. Here, careful measurements of both sheathing and siding ensured that soffit vent was not closed off.

plate and studs for the long wall, and then raised them into position. I shimmed the gap between the sole plate and the angled overhang. (Nailing the plate directly to the overhang and angle-cutting each stud to butt it is not only harder work, it robs you of a flat edge for nailing the siding panels.)

When the framing was done, I marked and cut the wallboard to fit the appliances (see photos). The oven had a special build-in kit; the compactor needed none. Wrapped in a layer of insulation, the compactor is now more quiet.

Next, I closed in the wall with sheathing and added the exterior siding, leaving space for a door fashioned from siding. As a final interior trim, I mitered thin molding and tacked it around the built-in appliances.

Except for a few odds and ends, the whole project was completed in two evenings and one Saturday. In fact, installing the NuTone took less than an hour, yet it replaced a counter full of clutter.

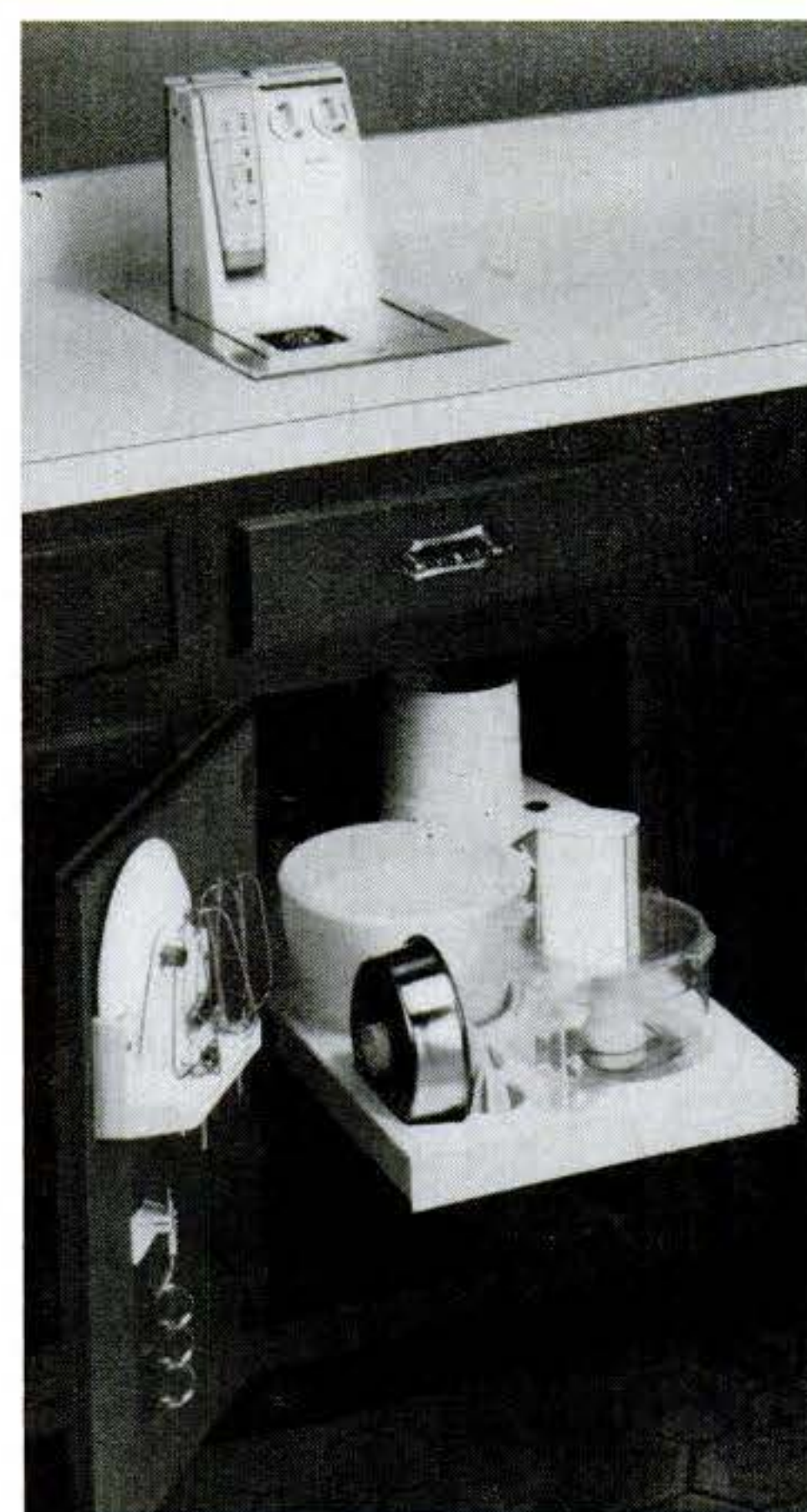
PS

Note: The booklet "Elbow Room" offers other expansion ideas adaptable to kitchens. For book plus construction details, send 50¢ to Western Woods Product Assn., Dept. 545-6 P, Yeon Bldg., Portland, Ore. 97204. For a more ambitious expansion, send \$1.00 to American Plywood Assn., 1119 A St., Tacoma Wash. 98401, for an "Add a Room" kit.

Cordless appliance centers introduce food processors

A small section of countertop and one standard 18-inch cabinet are all you need to house the new Ronson single-tray Foodmatic (right). The new food-processor attachment (front right in tray) does the work of several appliances. Unlike separately powered processors, the Foodmatic's is cordless and runs off the 1/2-hp variable-speed motor housed in the countertop control unit. The motor has "infinite speed control" for smooth adjustments. When not in use, the control center folds down flush with the countertop. Besides the food processor, the \$530 single-tray model includes a mixer and bowls, a knife sharpener, and a juicer.

NuTone is also now offering a food processor for its Food Center. NuTone's 1/3-hp variable-speed motor and solid-state control dial are housed in a single unit that's flush with the countertop. There's no separate appliance storage tray—an advantage if you can't spare the cabinet space. Though each NuTone appliance is priced separately, a collection comparable to that offered in the Ronson single-tray model costs about \$293. Either kind of built-in appliance center will free a counter of wires.



WIN a week for 2 in HAWAII



or one of 199 RAINBOW WEEKENDS in an exciting HILTON HOTEL

Save on famous name brands and enter the big SWEEPSTAKES during

SPRING

HOME VALUE

DAYS

Grand prize is an all-expense paid trip for two to Hawaii! You could also win one of 199 Rainbow Weekends for two at a Hilton Hotel anywhere in the U.S.A. To win, just fill out the coupon below and deposit it at any participating Hardware/Housewares Store displaying the Spring Home Value Days symbol, any time from April 15 to May 31, 1978.



National
Retail Hardware
Association

NOW AT PARTICIPATING

STORES* Spring Hardware/Housewares Week, 1978, is sponsored by the National Retail Hardware Association and its 25 affiliated associations through more than 18,500 member stores everywhere.

*Note: Some participating stores may not stock all items shown.

USE THIS ENTRY BLANK

Name _____

Address _____

City _____ State _____ Zip _____

Dealer Name _____

Dealer Address _____

City _____

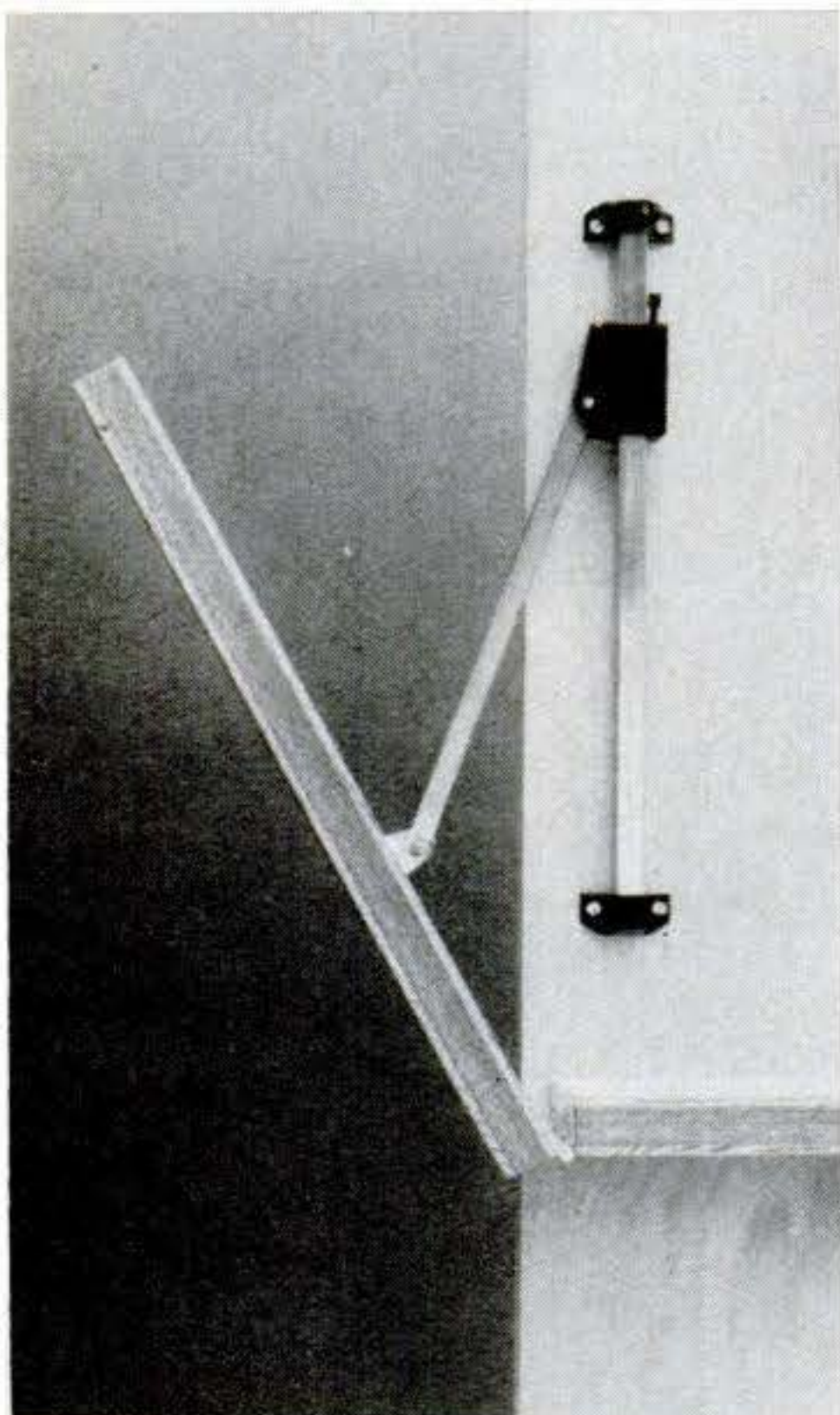
State _____ Zip _____

1978 Hardware/Housewares Contest subject to federal, state and local laws. Void where prohibited or restricted by law. Residents of Missouri may mail sweepstakes entries to participating stores or to NRHA, 770 N. High School Road, Indianapolis, IN 46224. All prizes will be awarded on a national basis.

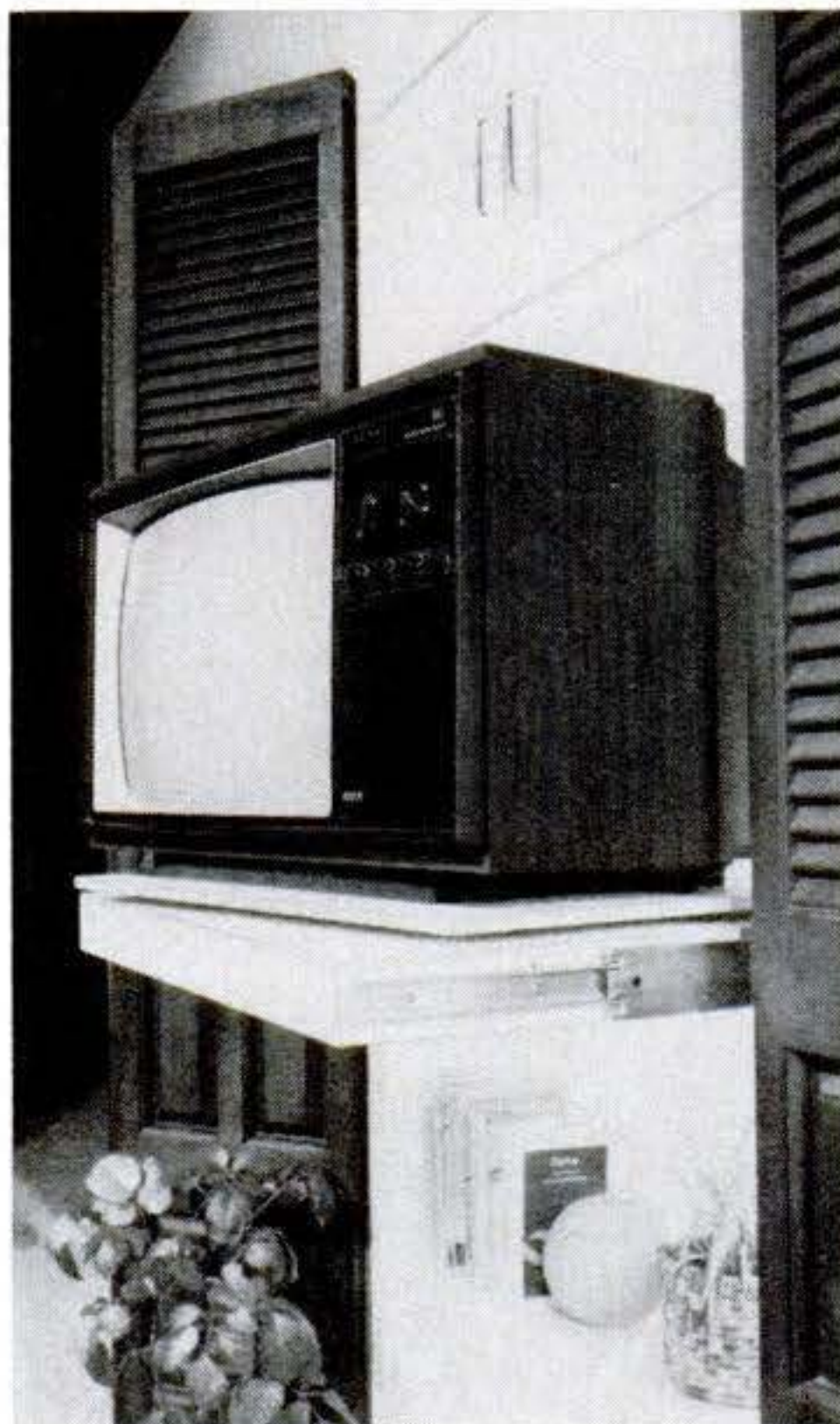


Beginning here, a special section for today's homeowner

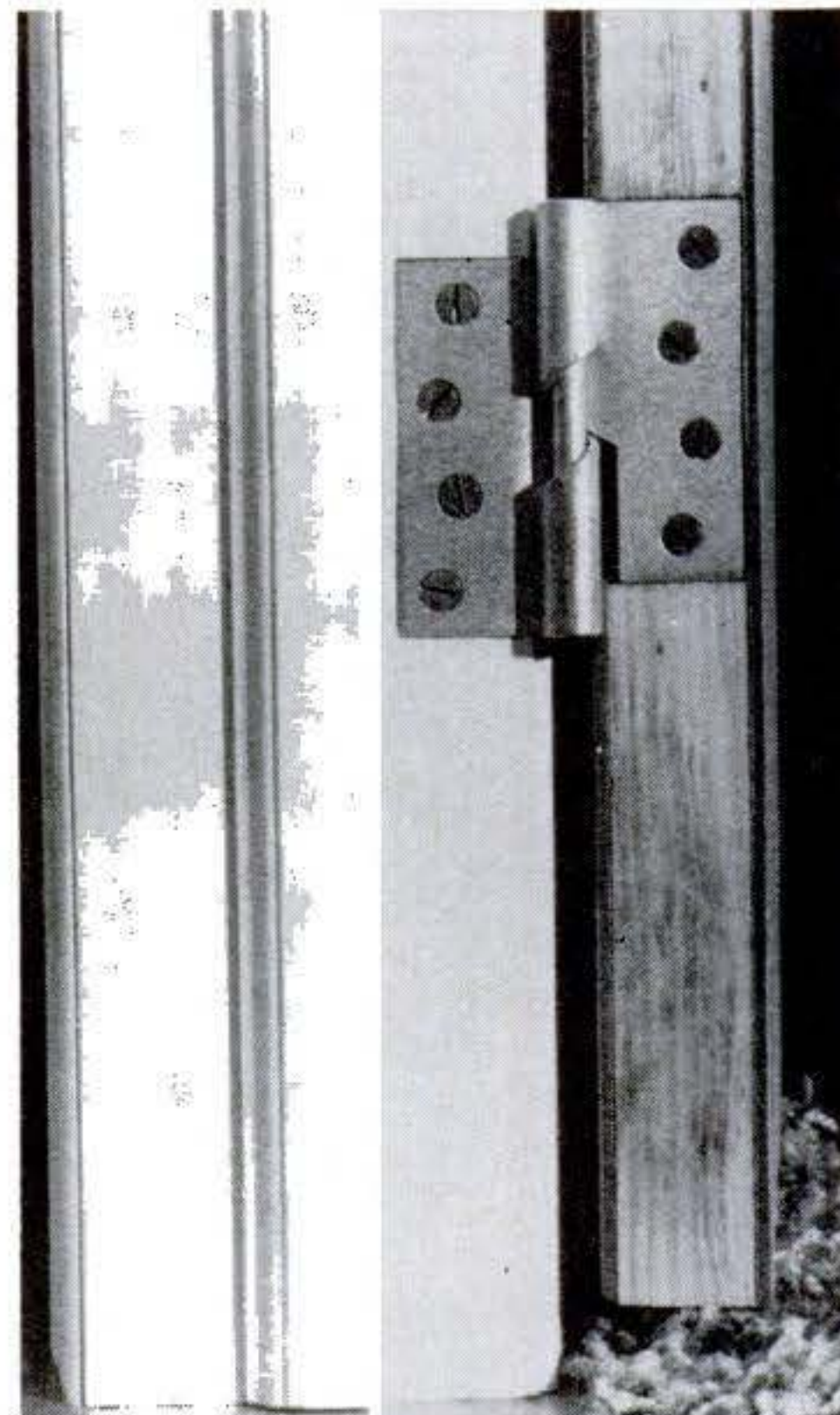
Makers of home-improvement and repair materials now take very seriously the homeowner who does it himself. The evidence? Explicit how-to instructions packaged with products; step-by-step demonstrations at your local hardware store or home-improvement center; and products once considered exclusively in the pro's domain now aimed at the do-it-yourselfer. As a complement to this trend, we've created this special section, tagged with the symbol at left. In the articles that follow you'll find exciting and useful new materials to improve your home and keep it functioning.



Drop-lid stay (left) works smoothly, adjusts for weight of flap. TV extension (center)



glides out and swivels to permit viewing from anywhere in room. Rising-butt hinge (right)



lets door clear deep carpet; its pitch causes door to swing shut automatically.

How to work with hardware that travels

Has it ever occurred to you that you spend a lot of time opening drawers, sliding doors, lifting and dropping lids, and stooping or stretching to reach into low-down cabinets or jam-packed closets?

If worn or outmoded fittings have you fumbling, perhaps it's time to look to new and better hardware that makes it easy to move things from here to there and back. We've rounded up a sampling of hardware for home-improvement projects, whether you're building from scratch or updating existing facilities and furni-

ture. We've confined ourselves to hardware that *travels*, omitting conventional pivots such as hinges (except those that work in special ways).

Sliding-door hardware

There are three basic methods of installing sliding doors: single, biparting, and bypassing. A single installation, as the term implies, refers to a single door that rides on a single track installed either on the outside of a partition wall or within it, so that the door disappears when opened (pocket door).

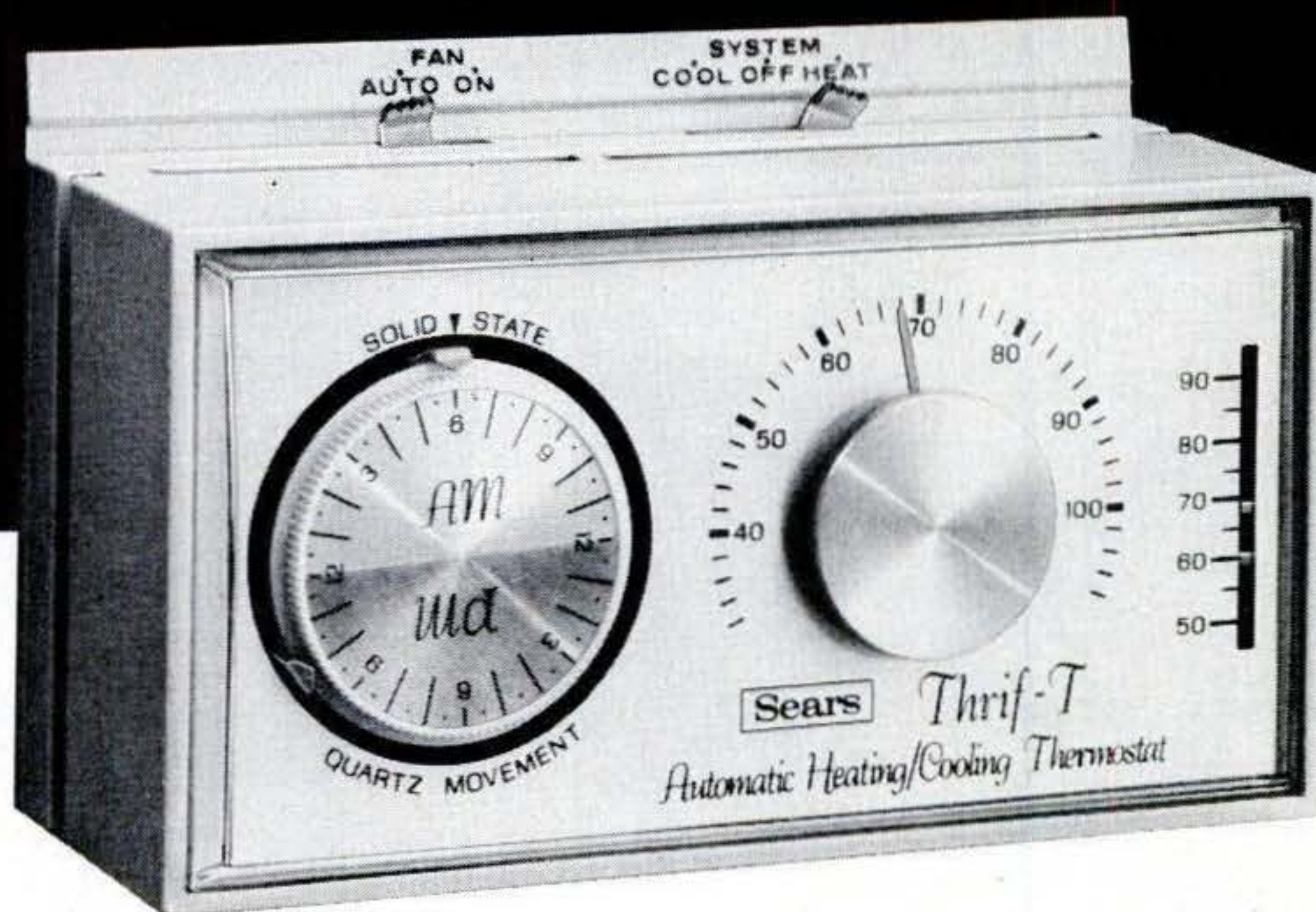
A biparting installation is one in which two doors travel on a single track and butt against each other at the center when closed. Here, too, installation may be on the outside or within the wall. It's mechanically similar to a single door, but requires twice the track length and number of carriers.

In a bypassing arrangement, two doors travel side by side on a double-rail track. This permits them to bypass each other for the full length of the track, usually with a one-inch overlap at center in the closed position.

The choice of sliding-door hardware for any of these methods is dictated by four factors: panel thickness, weight, headroom clearance, and mode of installation. The hardware is available in a wide range of sizes to accommodate doors from 1/4" to 1 3/4"

Continued

Save on Sears Thrif-T Thermostats, and they'll help you save on fuel costs automatically.



Our Thrif-T Thermostats are another group of GreenSaver products from Sears. Because these automatic thermostats help you hold down the energy dollars that go into heating or cooling your home.

There's a Sears Thrif-T Thermostat with a Single Set-Back. In winter, it can automatically turn down your heat while you sleep, then turn the heat back up before you get up. With air conditioning in summer, it automatically sets the temperature up while you are away at work. Then turns it down at a pre-set time before you get home.

There's also a Sears Thrif-T Thermostat with a Dual Set-Back. It gives you two separate timing functions that automatically raise and lower temperatures during both your sleeping hours and the hours you're away from home.

These GreenSavers work for you whether you use oil, gas or electricity. They replace most existing thermostats quickly and easily. There's no additional wiring. A screwdriver is all you need. The 24-hour quartz timer runs on a special, long-lasting NiCad battery that recharges itself.

So save now at sale prices. And start saving on fuel automatically from then on.

Here's the kind of heating/cooling savings Sears Thrif-T Thermostat can help you achieve by automatically changing the temperature twice a day.

Approximate Percent of Energy Savings

	Heating* (nighttime setback)		Cooling* (daytime setup)
	5°	10°	5°
ATLANTA	11%	15%	9%
CHICAGO	7	11	16
DALLAS	11	15	8
LOS ANGELES	12	16	20
MINNEAPOLIS	5	9	8
PITTSBURGH	7	11	10
ST. LOUIS	8	12	9
SEATTLE	8	12	9

*Above savings are based on computer study of a one-story home of 900 square feet with four people in the household. Heating savings based on daytime setting of 75° and nighttime setback from 10PM to 6AM. Cooling savings based on 75° nighttime setting and daytime setup period from 5AM to 4PM. Your savings may vary.

ON SALE

at most Sears retail stores

SAVE \$5 or \$10

HEATING/COOLING UNIT

Single Set-Back

REG. **\$54⁹⁹** NOW **\$44⁹⁹**

Dual Set-Back

REG. **\$59⁹⁹** NOW **\$49⁹⁹**

HEATING ONLY UNIT

Single Set-Back

REG. **\$44⁹⁹** NOW **\$39⁹⁹**

Dual Set-Back

REG. **\$49⁹⁹** NOW **\$44⁹⁹**

Sears

Sale starts
April 30,
ends
June 3, 1978

© Sears, Roebuck and Co. 1978

Prices and dates may vary in Alaska and Hawaii.

If you don't get cast iron, don't pay for cast iron.

It's worth remembering if you're in the market for a 10" radial-arm saw. And it may not seem like there's a whole lot of difference between them.

It's understandable. Compare features and, if you don't count small extras like our lower leaf blade guard and metric scale, they're almost exactly alike.

Almost. But not quite.

It's easy to miss unless you know just what to look for, but there's one feature that can affect your work nearly as much as all the rest put together.

The composition of the column support and track. Cast iron? Or die-cast aluminum?

Ours are cast iron.

The reason is performance.

The best possible performance.

First, cast iron is heavier than aluminum.

Second, cast iron doesn't expand like aluminum when it gets hot.

Third, cast iron doesn't deflect as easily as aluminum under the same loads.

Fourth, cast iron dampens vibration better than aluminum.

Fifth, cast iron wears better than aluminum.

Now, knowing all that, you should also know that you can probably buy somebody else's radial-arm saw for a few dollars less than the Rockwell 33-215.

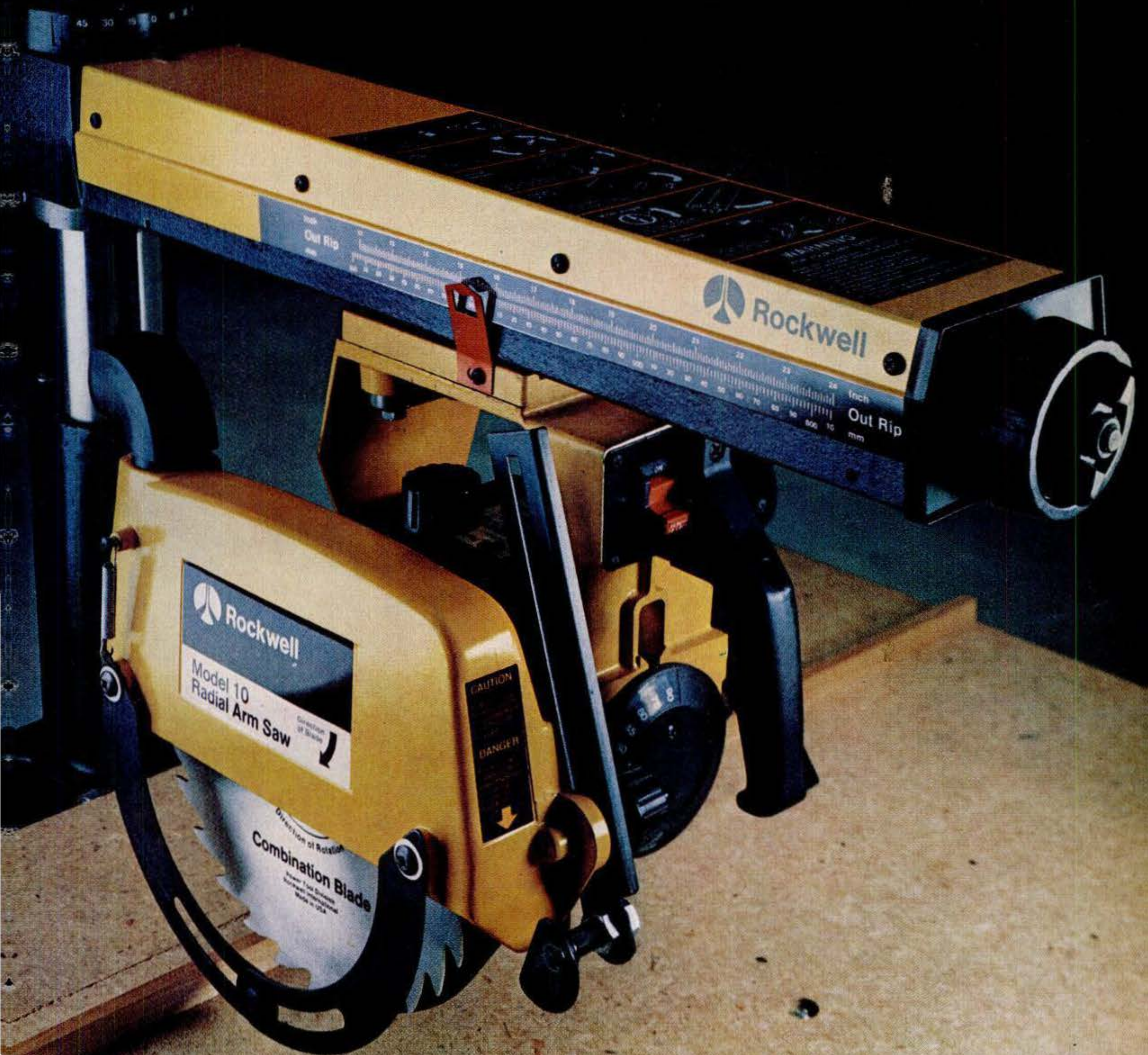
But even if it were \$100 less, you'd still have to ask yourself a pretty important question.

Can your work really afford it?



Rockwell International

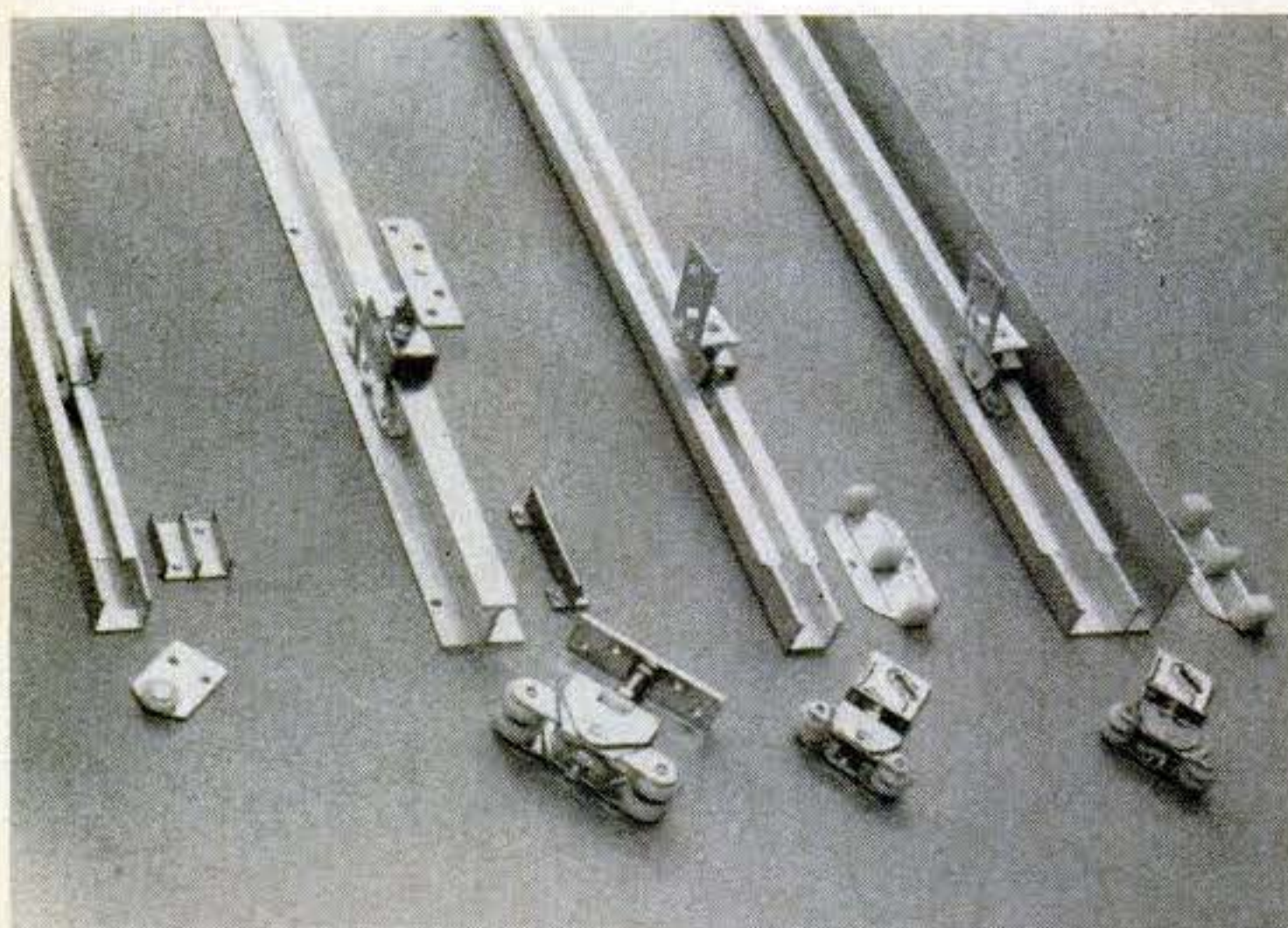
Introducing the cast-iron Rockwell 10" Radial-Arm Saw.



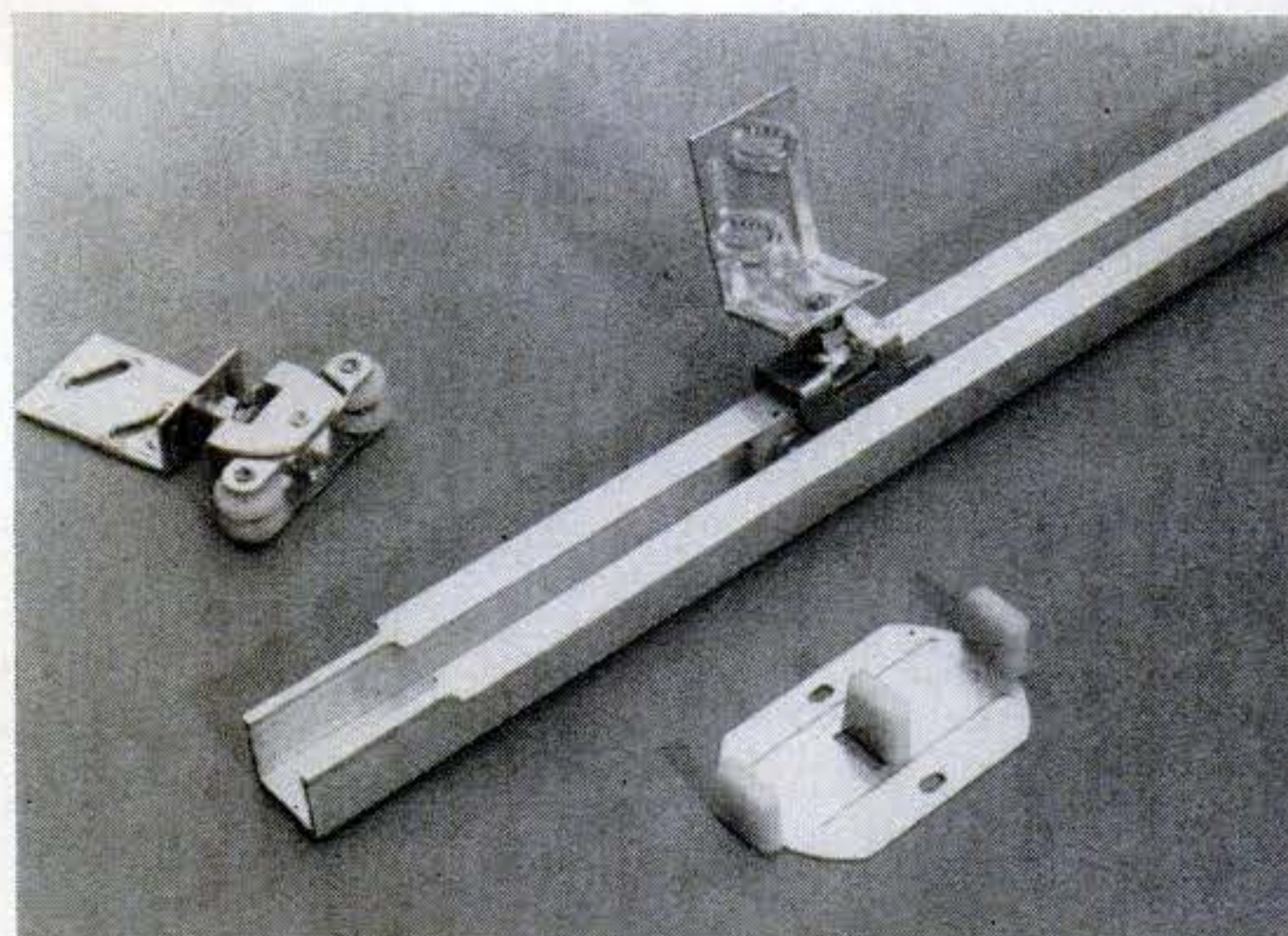
See the Yellow Pages under "Tools-Electric" for your nearest Rockwell dealer. Or write Power Tool Division, Rockwell International, 6263 Poplar Ave. Memphis, Tenn. 38138.

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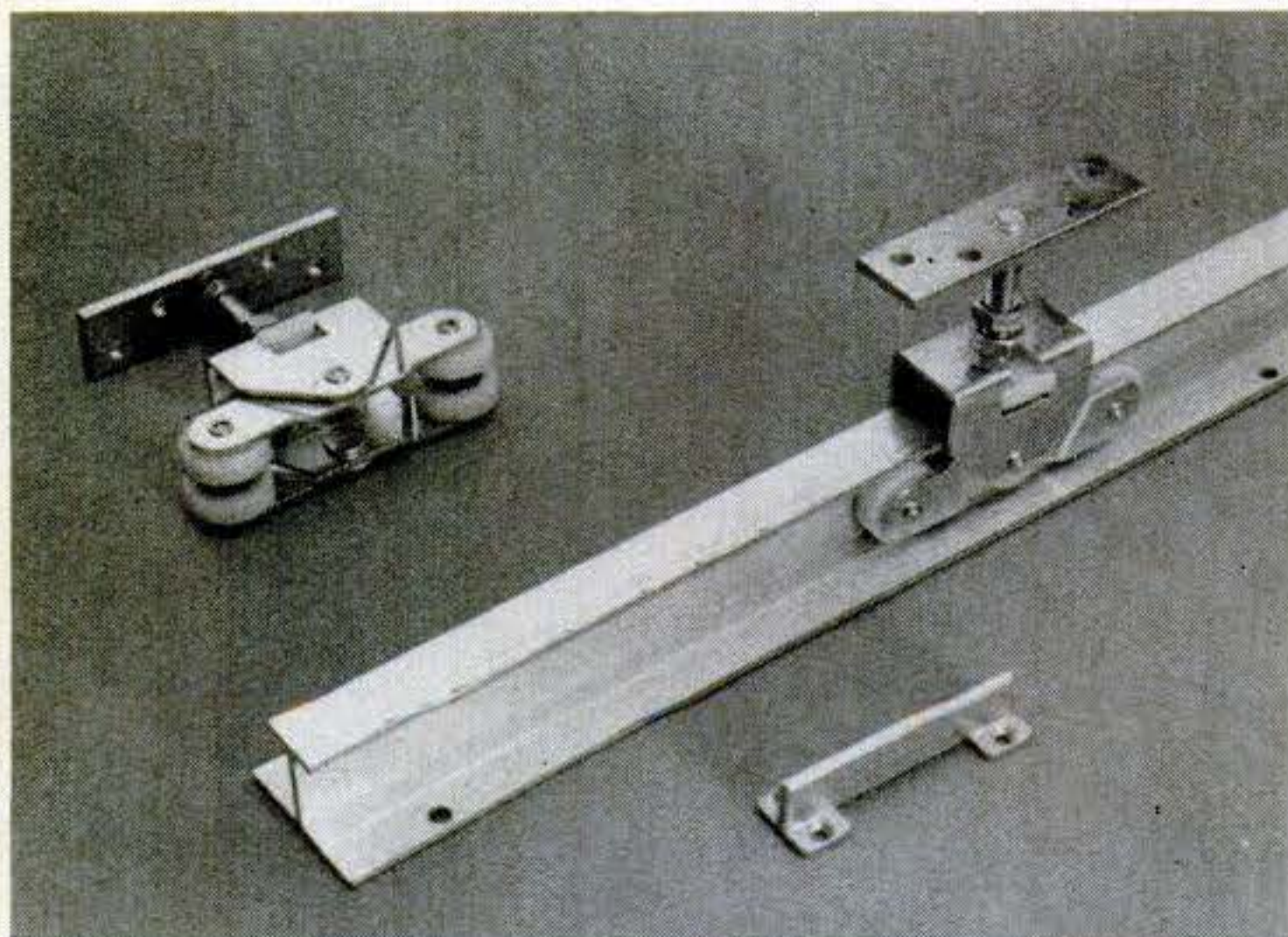
Sliding-door hardware



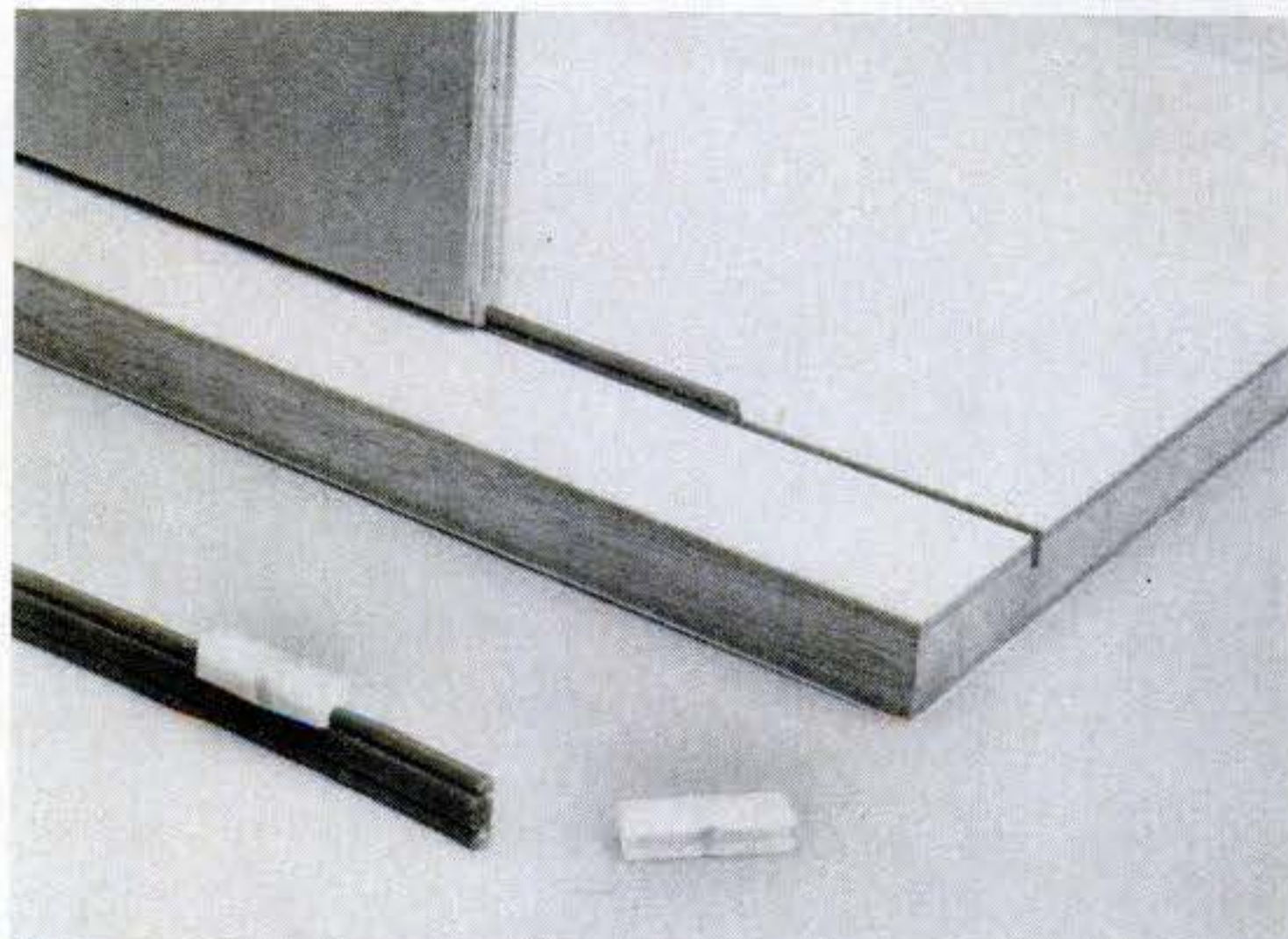
Sliding-door hardware from Grant can handle basic applications (see text). Shown (left to right): Bantam 912 bypassing, 1230 single-door set, 72-118 bypassing, and F 72-138 fascia bypassing.



Side-mounting carrier attaches to side of door; serrations in apron permit vertical adjustment. Rocker arm allows constant wheel contact with track. (All tracks shown are upside-down.)

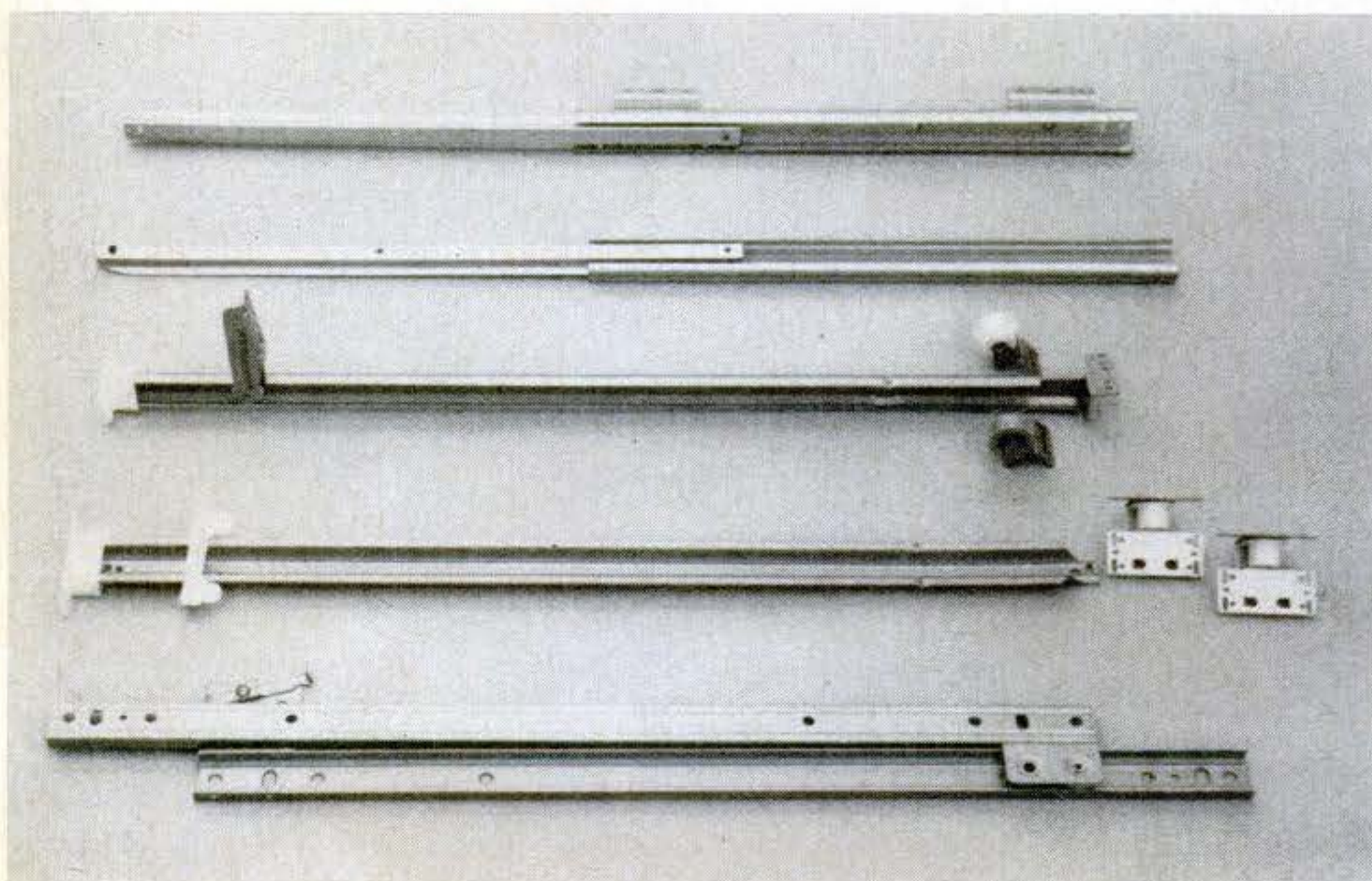


Pendant-type carrier is center-hung for greater stability in motion. It can be adjusted vertically and horizontally. Flat plate mounts to top edge of door panel.



Loc Trac system employs a plastic track that is inserted into a $\frac{1}{8}$ -inch-by- $\frac{3}{8}$ -inch-deep saw kerf. Pair of nylon slides (foreground) recessed into door bottom rides smoothly over the track.

Slides for drawers and shelves



thick and as heavy as 300 lbs. Headroom requirements (the space between the top of the door and the header) vary between 1" and $3\frac{1}{4}$ ". Select your hardware accordingly.

When shopping, go for quality goods; they're only slightly more costly than the bargain products and may prove less expensive in the long run, due to better performance and longer wear. Leading brand names for sliding-door hardware are Grant and Stanley.

A cross section of four basic Grant sliding-door sets is shown in an accompanying photo. The tracks are aluminum extrusions, and the rollers

Continued

Drawer-slide variations (top to bottom): #702 and 703 universal mounting; #675 and 452 single-track center mounting; and #900 side mounting. All are HDI products.

"A government report sold me on solar energy." *W. Victor Fiore*

Heating water for bathing, washing clothes and dishes can amount to 15% to 40% of an average family's total yearly heating bill. So Victor Fiore installed a Grumman Sunstream™ Solar Domestic Water Heating System to help reduce his rising energy costs.

"Because of my technical background, using the energy of the sun to make our hot water made sense. Since I put in my system, I think it's great, and I expect we'll save a good deal with it."

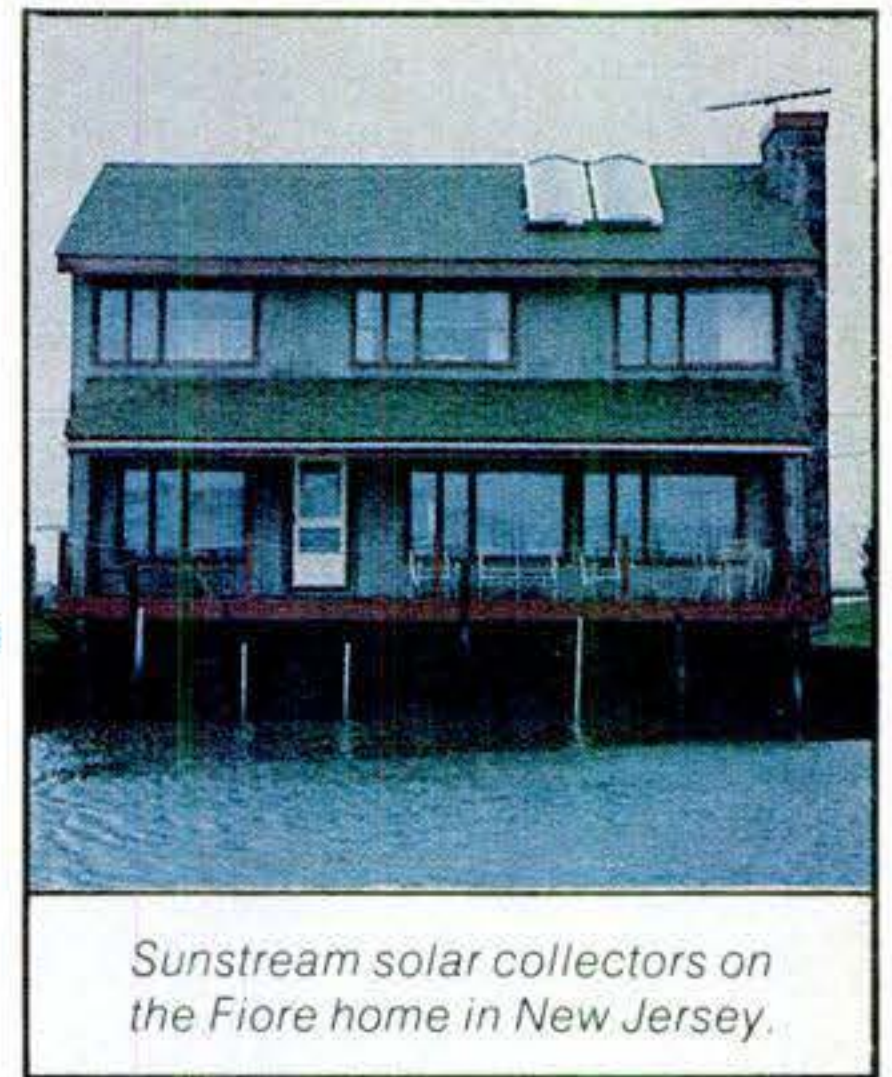
Learn how you can use the sun's free energy like Victor Fiore. Write Grumman Sunstream, Dept. H405, 4175 Veterans Memorial Highway, Ronkonkoma, NY 11779.

GRUMMAN Sunstream™

The reliable source

A product of Grumman Energy Systems, Inc.

Sunstream is a product of Grumman technology, which landed Americans on the moon. Grumman stands for reliability in Gulfstream executive jets, Grumman trucks, canoes and Pearson yachts.



Sunstream solar collectors on the Fiore home in New Jersey.

Suggested retail prices start at \$1,238 plus transportation, local taxes and dealer installation. Specifications and prices are subject to change without notice.



VISIT YOUR HANDY HARDWARE HOME CENTER NOW AND SAVE

WEED EATER®

In the war against grass and weeds, you need a WEED EATER® brand electric trimmer/edger. It trims, mows and edges with nylon line. Quickly and safely.

So ask for a WEED EATER® brand trimmer by name. It's THE ULTIMATE WEAPON for people with better things to do than their lawn.

For your nearest WEED EATER® dealer, see your Yellow Pages or call toll-free 1-800-447-4700. In Illinois, call 1-800-322-4400. A complete line of trimmers from \$19.95.

THE ULTIMATE WEAPON.

WEED EATER®, Inc. a subsidiary of Emerson Electric Co.

Hardware that travels

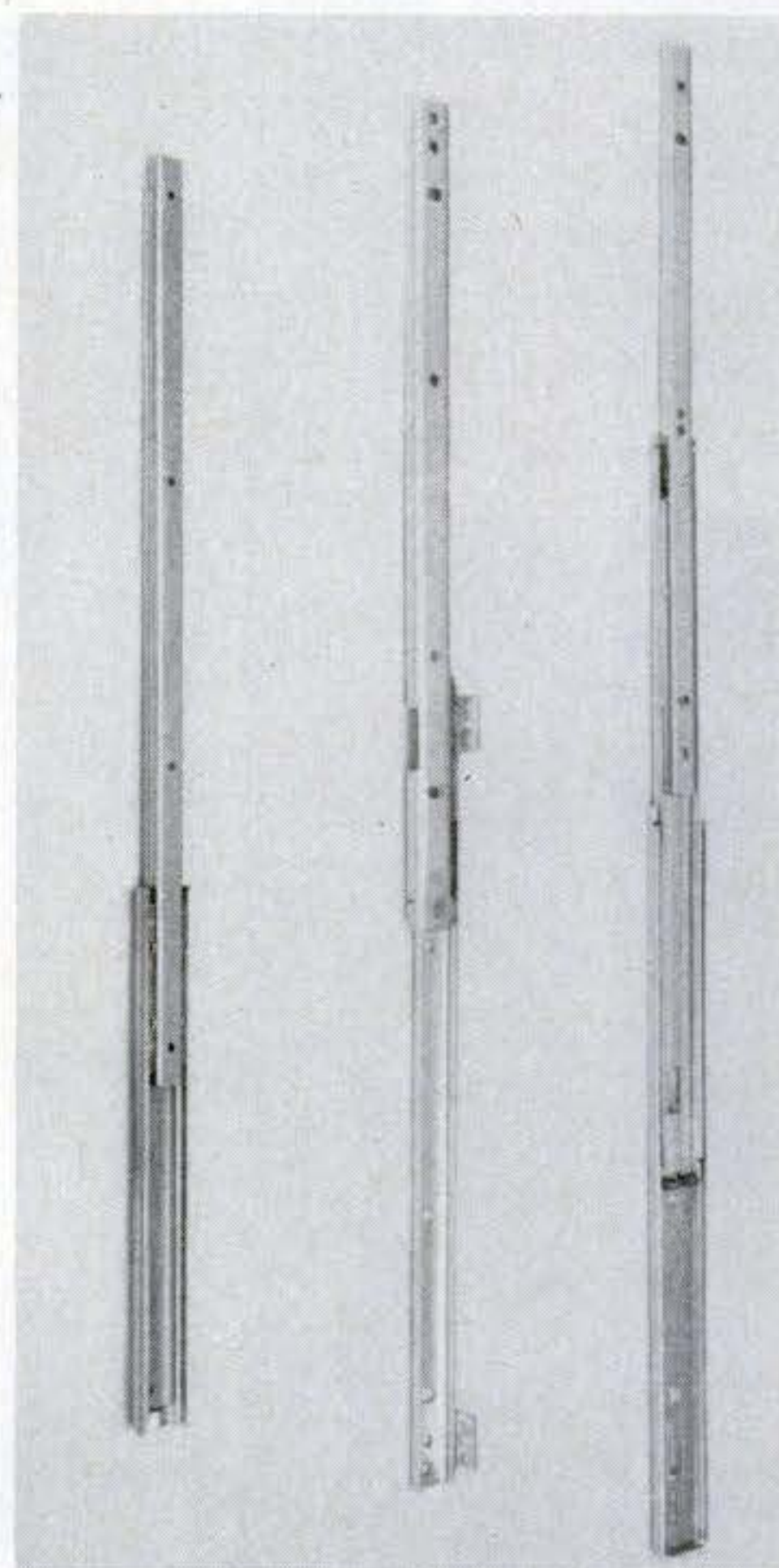
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are nylon—a good combination for quiet, smooth travel. The heavy-duty units feature four-wheel carriers mounted on pivoting rocker arms that allow constant wheel contact with the track.

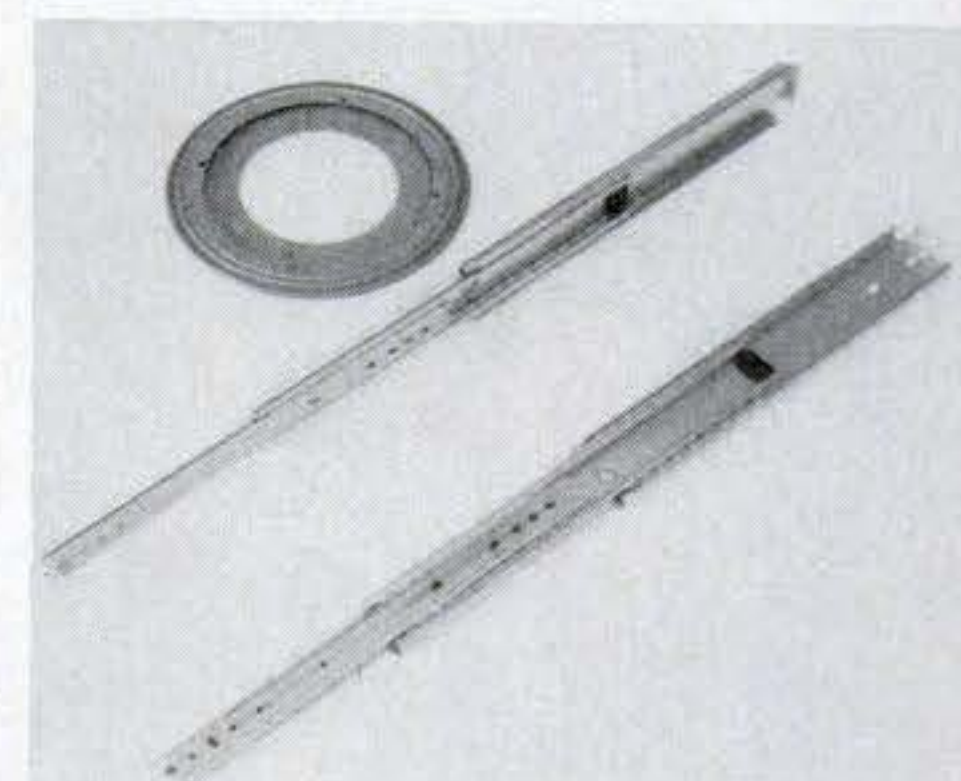
The Bantam 912 is designed for bypassing panels in cabinets, wardrobes, and lightweight movable partitions that are 1/2" thick—though it's also available with carriers that accept 1/4"- and 3/8"-thick panels. The 912 requires only a 1" headroom.

The model 1230 is a heavy-duty single-door unit recommended for de-

Continued



Three special slides (left to right): #328 full extension, #344 add-a-drawer, and "A" record player. Latter has silencer spring for minimum vibration. All are from Grant.



Full-extension slide (these are Grant #3320) and lazy-Susan swivel are for TV extension chassis. Slides may be side- or bottom-mounted.

After 3 years and 2 million miles, your motor oil has arrived.

The Motor Oil that saves you money three ways. It's New Generation All Season Motor Oil from Conoco. It lubricates and protects auto engines for 15,000 miles, or one year, whichever comes first. It exceeds API service SE — available as SAE 10W-20W-40 grade.

We've been developing and perfecting this new oil for more than three years. And testing it for 2 million miles. In autos, vans and pickup trucks, old and new

cars. In cities, on the highway, in all kinds of weather.

We found New Generation All Season protected the engines up to *twice* the time span and *double* the mileage. However, in cars under warranty, change according to manufacturers' requirements.

Today's engines are complex machines. And, many things, such as dirty spark plugs, faulty carburetor, dirty air filter can affect their over-all perform-

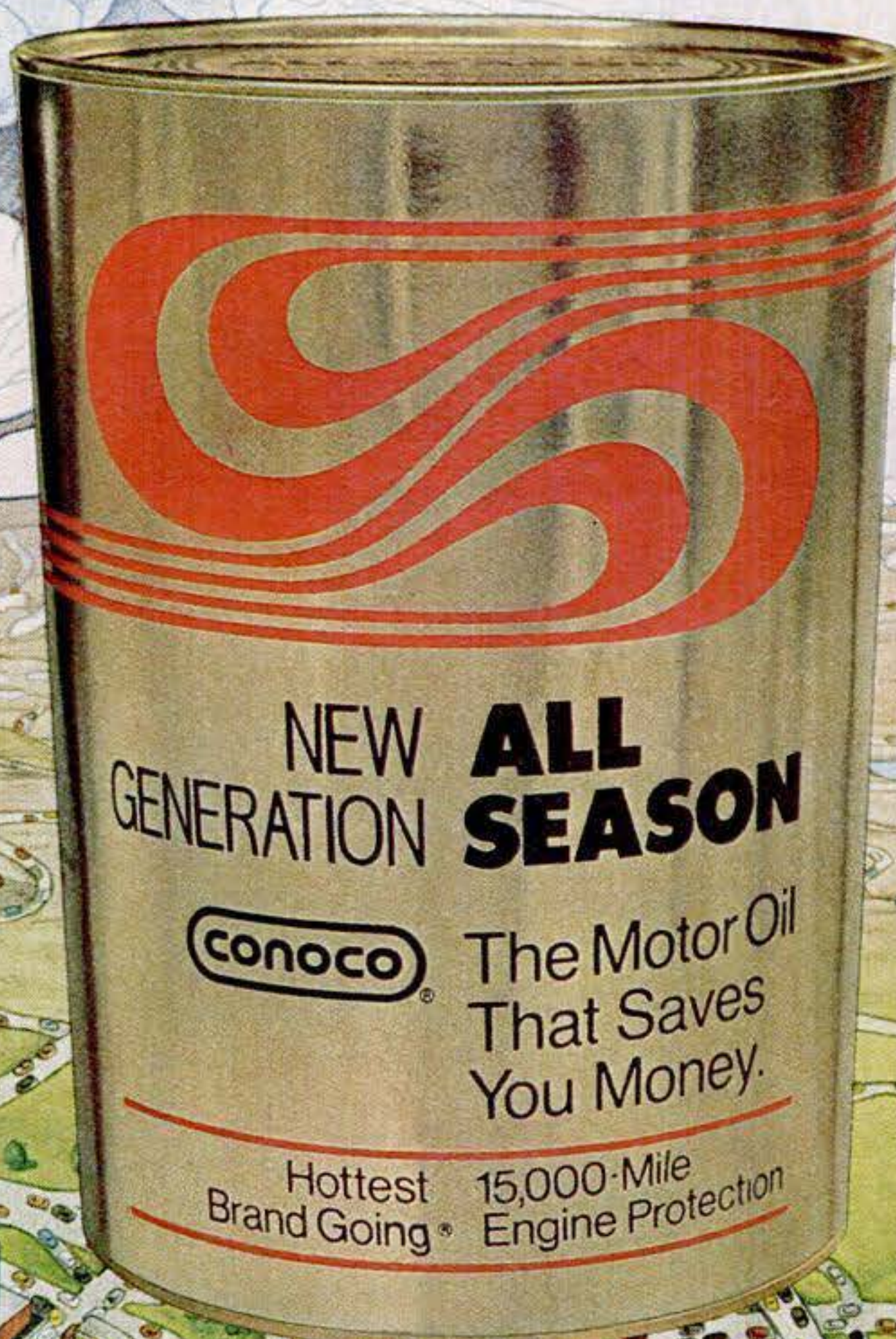
ance. But with proper car maintenance and this superb new oil from Conoco, engines can perform more efficiently and improve gas mileage.

And best of all, this new oil is priced competitively with other new generation oils.

So if you want to benefit 3 ways, try Conoco's New Generation All Season Motor Oil today.

conoco®

HOTTEST BRAND GOING®



REMINGTON® LIMB 'N TRIM 14-INCH ELECTRIC CHAIN SAW

Cuts trees up to 28 inches in diameter. High performance 2 H.P. motor. 14-inch guide bar. Lightweight. Double insulated for your safety. U. L. listed. (75762)



\$4999

WERNER® 16-FOOT EXTENSION LADDER

13-foot working length. Alflo- rung joints prevent twisting. Flat 1 1/2 inch steps. 200 lb. rated load. U. L. listed. (D1116-2)

\$3799

6-FOOT ALUMINUM STEPLADDER

Ideal for every household job. 225 lb. load rating. U. L. listed (366)

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GB YARD GARD®

WELDED FENCE

Use it to enclose yard, garden, swimming pool ... 36 inches high. 50 feet long. Double vinyl coated. Rustproof. Won't chip or peel. No rough edges. (132301-36-50)

\$2388



EVERYTHING FOR THE HOME-FIXER...
**Shop at the store with the
Sentry on the door!**

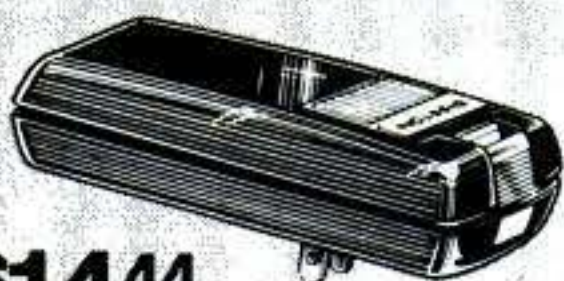


Want to improve your home? Beautify your lawn? Plant a garden? Do hundreds of do-it-yourself jobs quickly, easily, economically? See your neighborhood Sentry hardware dealer ... One of 4,500 in the U.S., he's listed in the Yellow Pages under "hardware".



DISSTON® RECHARGEABLE POWERPACK™

For use with Disston Powerpack™ operated shop and garden tools. Plugs into wall outlet to recharge. Snaps into tool. (1000)



\$1444

DISSTON® CORDLESS SHRUB TRIMMER

Non-stick coating on double-edged 10 3/4 inch blade reduces friction. Prevents rust. Lightweight. Two handles for easy control. Powerpack not included. (1035)

\$1699



Sentry®

22-INCH CUT

POWER PROPELLED MOWER

Mowing's a cinch with this new model. Lift the handle. Front wheel power drive immediately engages. Grass discharges at side. 3 1/2 H.P. Briggs & Stratton engine. Four adjustable wheel height settings — 3/4 to 3 inches. (260-8)



\$14449

Crescent®

10-INCH ADJUSTABLE WRENCH

Knurl opens, closes jaws fast. Thin head gets into tight places. Drop forged. Chrome plated. (AC110VH)



\$659

SKIL® 3/8-INCH RECHARGEABLE CORDLESS DRILL

Lightweight. Portable. High torque makes it easy to drill all types of material. Drives screws without pre-drilling. Reverses to remove screws. Trigger safety lock. Chuck key stores in handle. Recharging unit included. U. L. listed. (2002)



\$3488

RAND McNALLY ROAD ATLAS 1978 EDITION UNITED STATES • CANADA • MEXICO



Includes metropolitan and state maps. Mileage charts. City, state, county index. U.S. interstate system map. Time zone data. Telephone area codes, etc. This is same Atlas that usually sells for \$3.95.

only **\$197**

STANLEY®

POWERLOCK® II 16-FOOT TAPE

Graduated in easy-to-read 16ths on both edges of long-life yellow blade. Power return. Positive blade lock. (PL316HWW)



\$749

Rockwell 10-INCH HOMECRAFT® MOTORIZED TABLE SAW



When you buy this saw at \$259.99, you get a ½ H.P. router for a penny! Saw has front controls. Blade tilts for bevel cut. Rip fence is self-aligning. High performance motor. Two extension wings and stand included. 28,000 R.P.M. router is complete with ¼ inch collet and wrench. U. L. listed. (34-676)

\$259.99 plus 1¢ (with saw) **\$260** complete for router

Sentry®

DELUXE 9-INCH PAINT ROLLER COVER

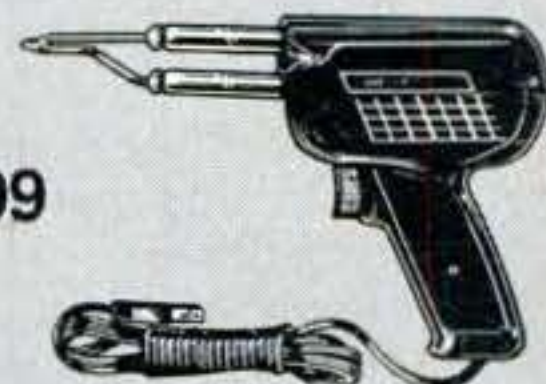
Works well with all types of paint... latex, oil base, semi and high gloss. (R-362)

88¢



Weller® HEAVY-DUTY SOLDERING GUN

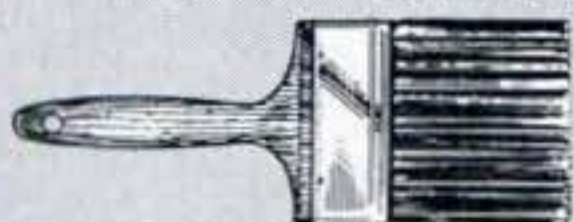
Makes every soldering job easy. Trigger selection for high or low output. High efficiency, heavy gauge copper soldering tip. Twin lights illuminate work. (D550H)



\$16.99

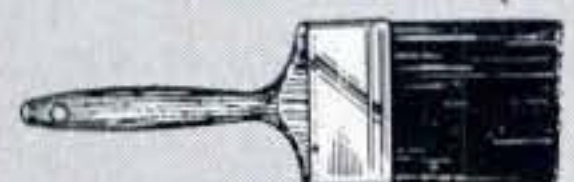
Sentry®

SILVER POLYESTER* PAINT BRUSHES



\$4.44

4-inch Varnish/Wall (5531)



\$2.77

3-inch Varnish/Wall (5531)



\$1.88

2-inch Varnish/Wall (5531)



\$1.44

1½ inch Varnish/Wall (5531)



\$2.22

1½ inch Sash (5535)

*For all kinds of paint. Polyester stays resilient. Holds its shape. Lasts three times longer than bristles.

WD-40®

Penetrates. Stops squeaks, rust, corrosion. Keeps tools like new. Loosens sticky mechanisms, locks, hinges. Lubricates moving parts. (40011)

\$1.33 9 ounces

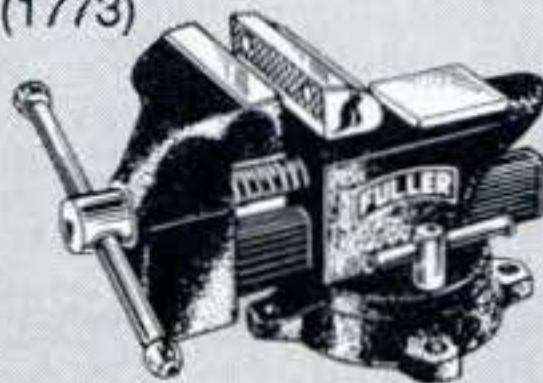


FULLER®
AN INTERNATIONAL GROUP

3-INCH

SWIVEL-BASE HOMEOWNER'S VISE

Belongs in every tool kit. Unbreakable ductile steel. Replaceable, hardened-face jaws. Large anvil and horn. Permanent pipe jaws. (1773)



\$10.99

CARBORUNDUM ASSORTED GENERAL PURPOSE SANDPAPER

Long-lasting pre-cut aluminum oxide sheets fit oscillating and orbital sanders. Assortment includes two sheets each of fine, medium, coarse grits. (8019)



49¢

Rockwell 3/8-INCH VARIABLE SPEED DRILL KIT

Drills all types of materials. Speed adjustable. Can be preset and locked from 0 to 1,400 R.P.M.



Handy "Tool-Toter" case holds 13-piece twist drill set, 6-piece socket set, 4 screwdriver bits. U. L. listed. (4169)

\$27.99

EVEREADY® COMMANDER FLASHLIGHT



For tool kit, car, boat... anywhere dependable light is needed. Chrome plated case. Red safety glow ring. Includes two D cell batteries. (5251WB)

with coupon **\$1.64**

without coupon **\$2.19**

CLIP AND SAVE

JR. COMMANDER LANTERN

Tough, lightweight case. Break-resistant lens. Four D batteries. (3114WB)

\$2.84

with coupon
without coupon **\$3.65**



DISSTON® ABRADER

Sands, finishes in one easy operation. Works faster, lasts longer than sandpaper. Stainless steel finishing surface is etched with hundreds of sharp-edged pillars. (400F)



\$5.88

Merchandise, in this advertisement, is available from participating Sentry dealers only. Offer expires May 27, 1978. The 4,500 Sentry dealers own their stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores... Sentry Hardware Corporation, Cleveland, Ohio 44113.

AA-7946

VISIT YOUR HANDY HARDWARE HOME CENTER NOW AND SAVE

Hardware that travels

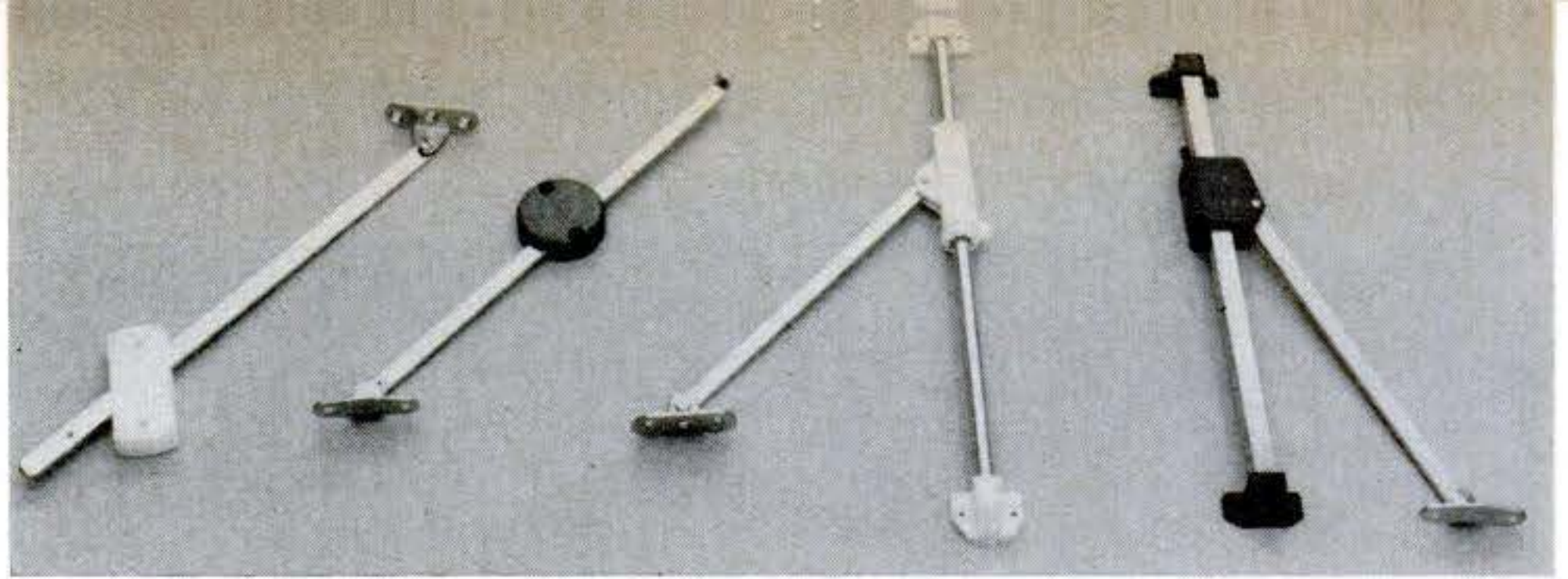
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sign applications that require the movement of heavy panels, space dividers, or large doors. A large four-wheel carrier with a center-hung pendant bolt and a flat plate mounts to the top edge of the panel.

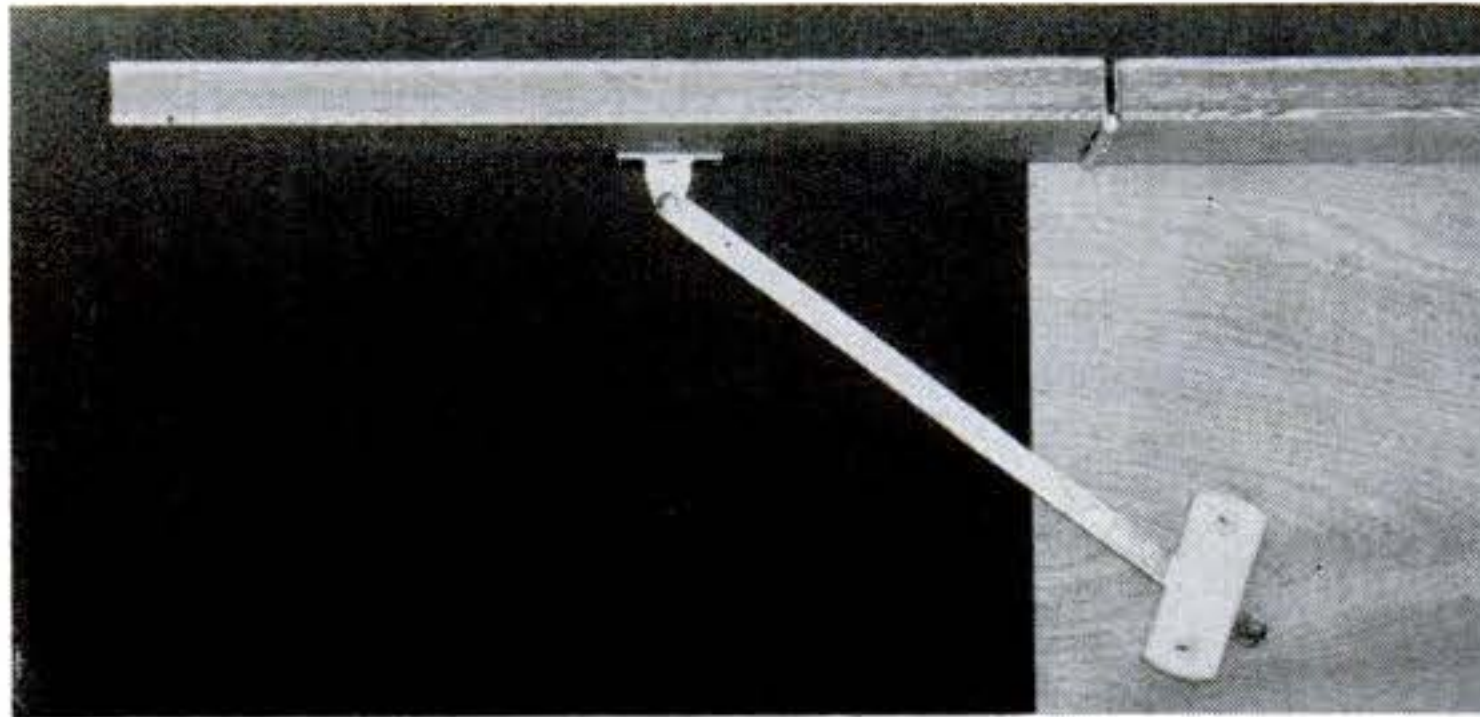
The model 72-118, a bypassing unit, is designed for 1½"-thick doors weighing up to 100 lbs. The carrier is a four-wheel, side-mount type with pivoting rocker arms.

The fourth sliding-door device shown is an F 72-138 fascia set. This is similar to the 118 with the exception that the track has a finished front face that conceals the door top and fittings. All sliding-door units are supplied with floor guides, as shown.

If you're thinking of installing a disappearing-pocket door, either in new construction or remodeling, take a look at Stanley's Pocket Frame Set (#2825). This includes an adjustable header unit, a split jamb and stud, and the necessary rolling hardware for hanging the door panel. For a biparting installation you use two of these frame sets butted with a special frame coupling (#2825-5). The kit will handle doors up to three feet wide, ¾" to 1¾" thick, weighing up to 100 lbs.



Four flap stays (left to right, above): KLS 200, Rotacam 250, 259A friction control, and 178 Regal. KLS 200 is for lift-up flaps (photo at left); it locks open automatically and is held in place by flap's weight. The others are for drop lids.



For small sliding doors you might consider using "soft" hardware such as Loc Trac. This novel system uses a self-lubricating, high-density plastic track that installs easily in a ⅛"-by-⅜"-deep saw kerf cut in the base of the cabinet. A pair of nylon slides (Nyslide #224) is inserted into a ¼"-by-¼" groove cut in the bottom of the door. The slides have slightly hooked

sides that lock onto the track. The door is engaged in the track by a slight downward thrust. Two parallel tracks are used for bypassing doors. The upper deep-channel section of a conventional aluminum or plastic sliding-door panel track is used at the top of the cabinet to keep the top of the door in line.

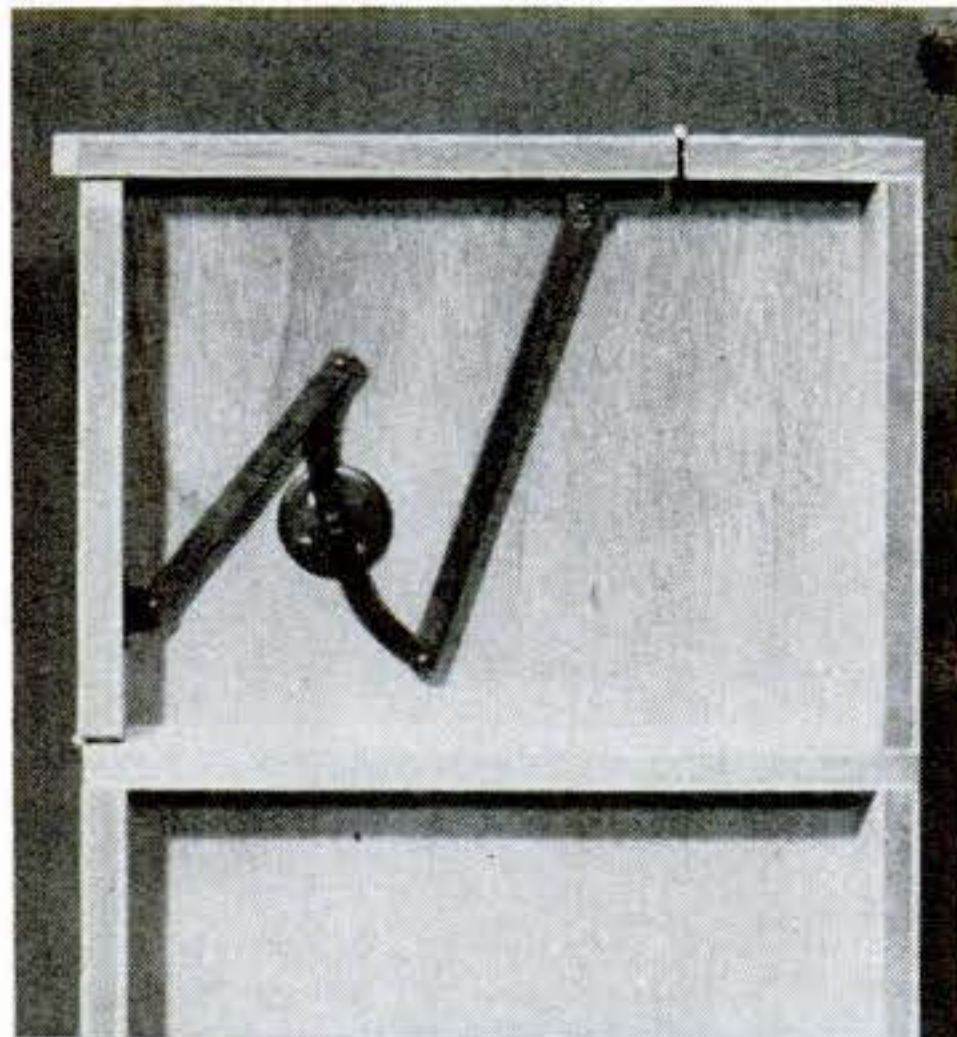
Drawer slides

Like sliding-door devices, drawer slides come in a wide range of sizes and load capacities and in several forms designed to meet the requirements of special applications.

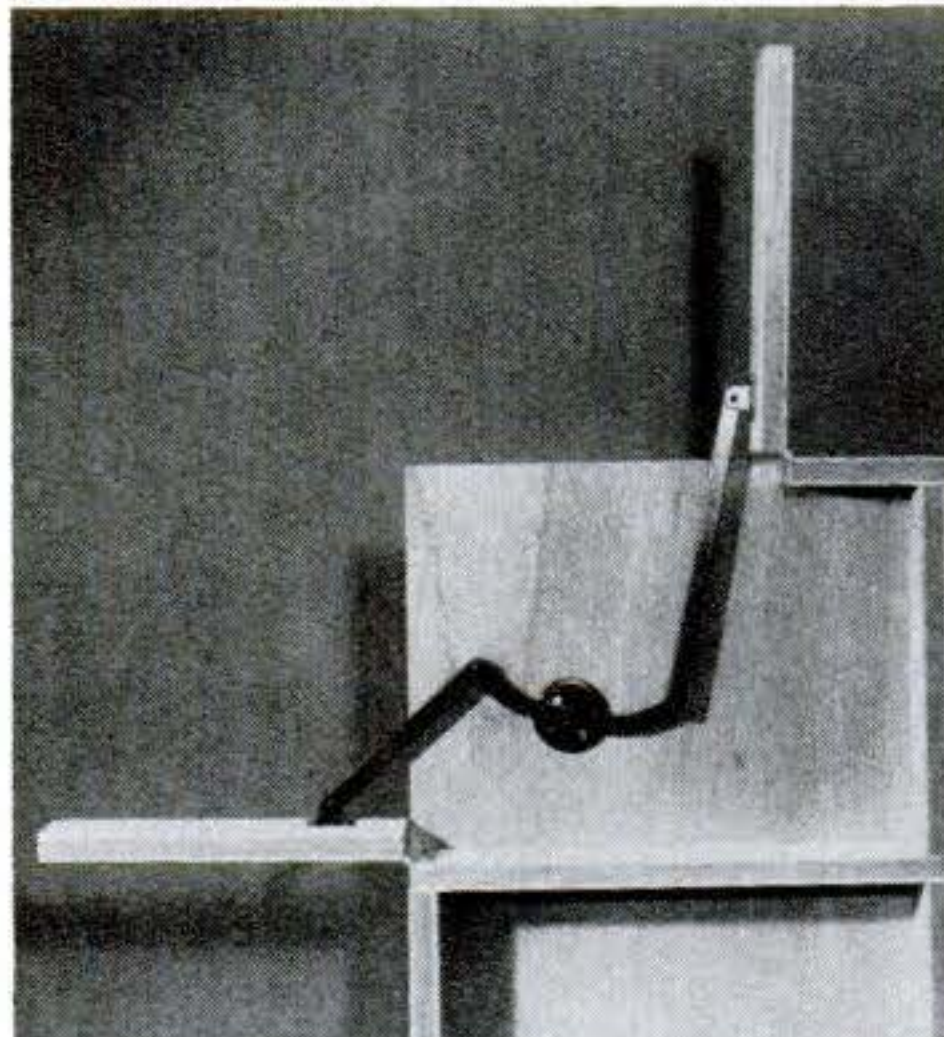
One of the most versatile is the universal mounting slide. It permits easy custom mounting of drawers, shelves, or table extensions almost anywhere with no need for side partitions. Special brackets allow top or bottom mounting. They're ideally suited for adding drawers to tables, vanities, counters, and deep shelves.

You can get easy access to the bottom of your kitchen cabinets by installing shallow pull-out drawers or simply flat boards that use universal mounting slides. A similar narrow cross-section slide, available without

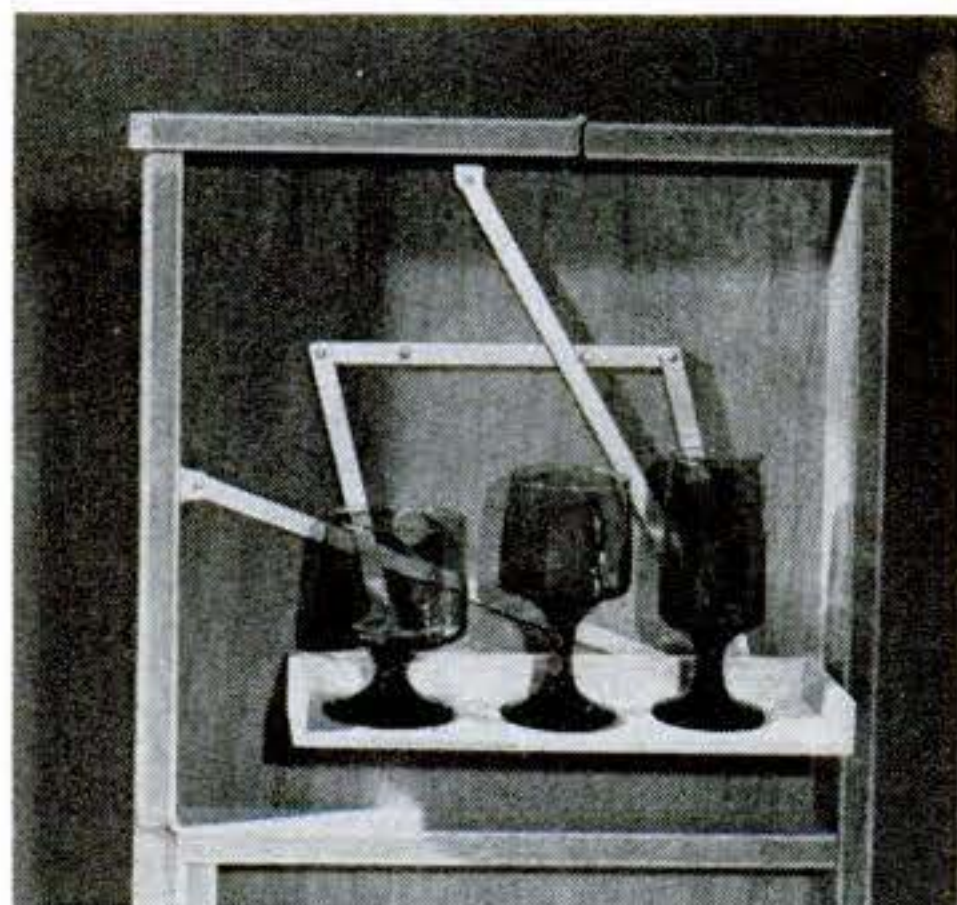
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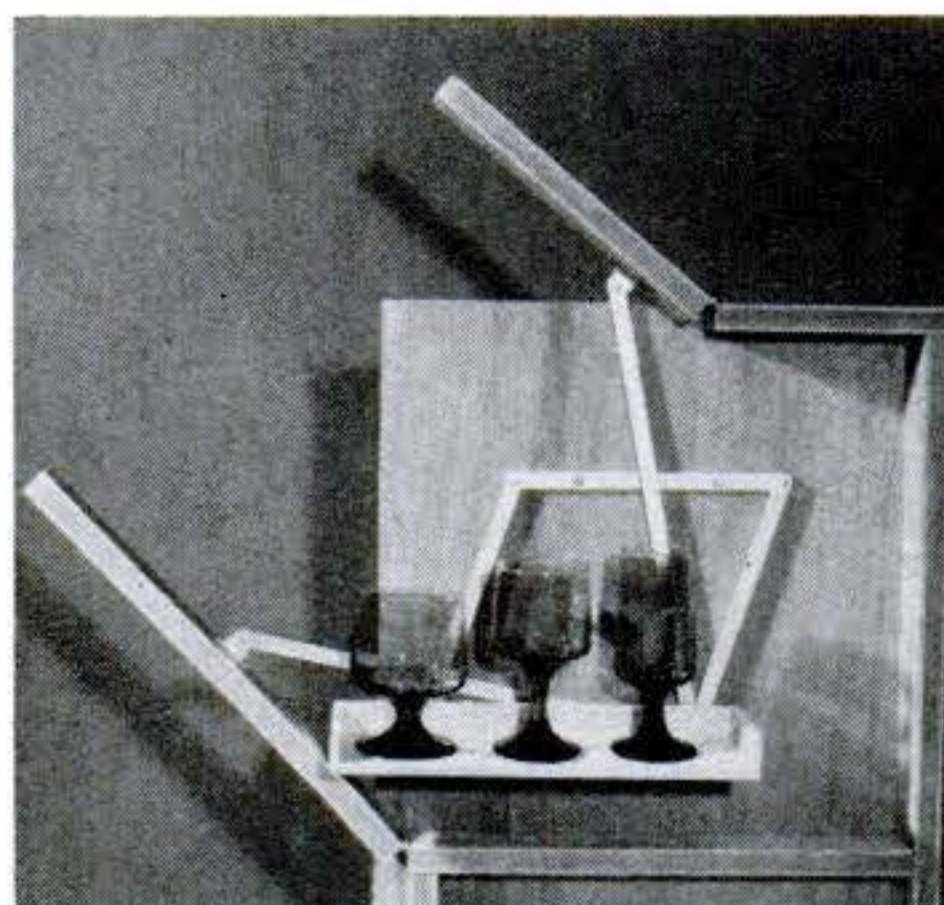
Cocktail-cabinet fittings are double-acting. Mounted inside cabinet, these units (Selby's



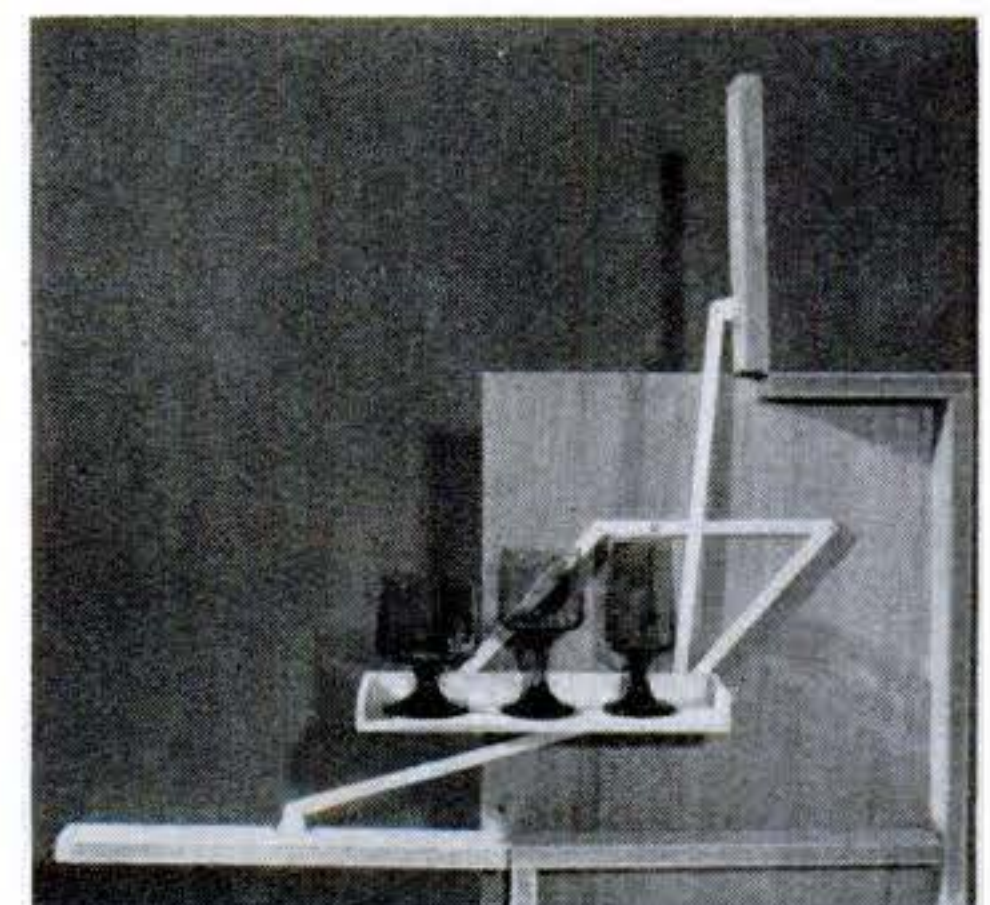
207) automatically raise top lid when front flap is opened (right).



Triple-action stay: When closed, glass tray is fully retracted (left). As front flap is low-



ered, top lid pushes upward and tray moves forward (center). At full open (right), tray



is positioned right up front for easy access. It's Selby's 215D.

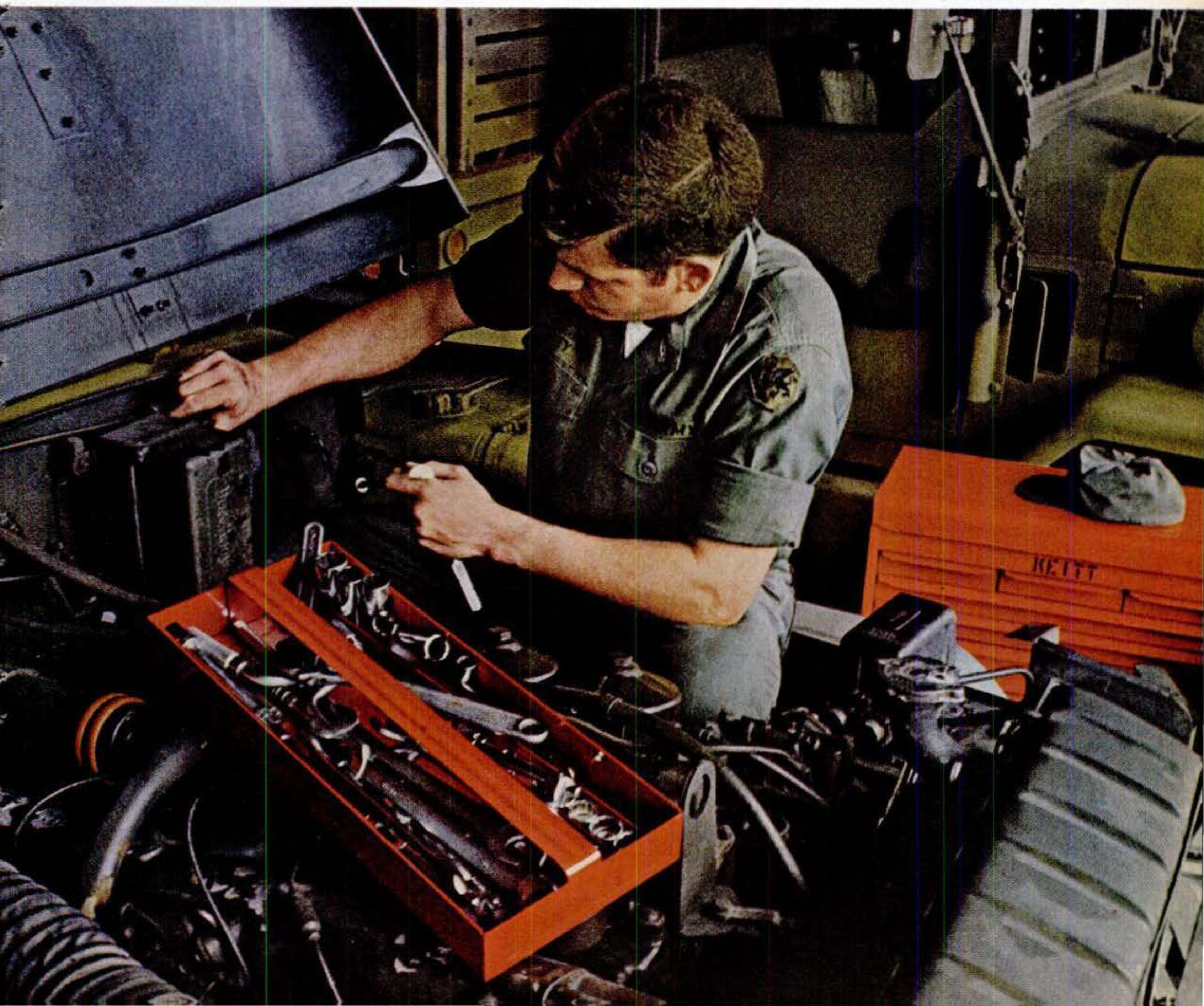
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Slide-out clothes hanger attaches to the bottom of a closet shelf, extends for easy ac-

cess. This piece of hardware can be used in any under-shelf application.

Some houses were never meant to be painted.



Architect: Architectural Workshop—Moscow, Idaho. John Anton Berg—Designer

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Available in 66 beautiful semi-transparent and solid colors. Please follow easy label directions. For more information, consult the Yellow Pages for your Olympic dealer or write: Olympic, 2233 112th Avenue N.E., Bellevue WA 98004.



Hardware that travels

[Continued]

brackets, can be used to install a pull-out vertical partition in base kitchen cabinets or workbenches—great for hanging utensils or tools. You merely mount a slide to the top and bottom of a $\frac{3}{4}$ " board, then attach the assembly to the top and bottom of the cabinet.

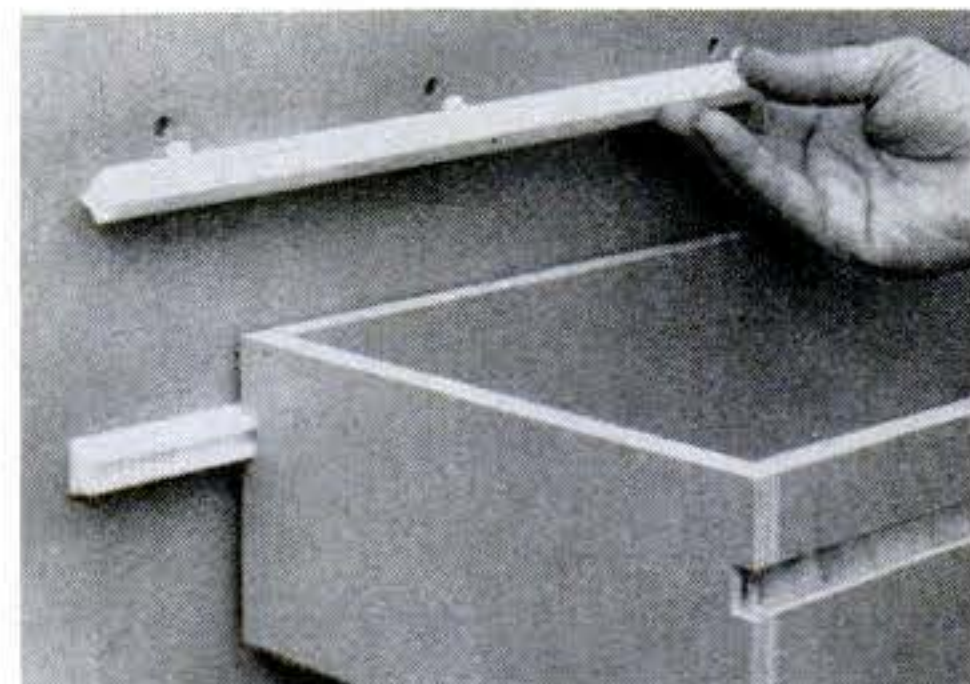
When you're mounting a record player or some other component for pull-out access in an audio cabinet or built-in, don't use just any slide. Use special record-player slides that are designed for the purpose. They travel extra smoothly and are vibration-free when extended. This type of slide can be either side- or bottom-mounted.

Many vintage kitchen cabinets and other furnishings with wood-to-wood contact drawers frequently develop problems. Drawers jam as a result of sagging or excessive side play caused by wear. Irregular framing of a case may make it impossible to substitute conventional side-mounted slides. But the solution can be quite simple: Use one of the single-track center-mounted slides. These consist of a steel rail that attaches between the front and rear of the case. A roller or plastic guide (depending on the style) attaches to the rear of the drawer and mates with the rail. A pair of rollers mounted on each side of the front rail creates a three-point contact for smooth, silent action.

For ordinary applications the conventional side-mounted drawer slide is used. This generally consists of a double track—one member mounts on the drawer, the other to the cabinet. Two or more rollers engage in each track to provide smooth, steady travel. Better-quality drawer slides have steel ball-bearing wheels with nylon tires.

Side lengths are generally available from 12" to 36" in even-inch increments. Drawer travel is usually about four or five inches less than the overall length of the slide, with one exception: Full-extension telescoping slides are available for drawers you wish to open fully.

The plastic drawer slide is of particular interest to homecraftsmen who build their own drawers. Its



Drive-in plastic drawer runners are easy to install without screws, and are quite efficient. They slide in grooves cut into the drawer sides.

Mock-up of cupboard with fold-up table shows how swing-leg hinge (inset, far right) functions. When the table is folded up, legs are inside and out of view. The legs are swung in 270-degree arc as table is brought down. Top edge of legs tuck under the table to support it when horizontal.

simplicity of installation and velvet-smooth operation are unique. This relatively new concept uses a molded plastic bar that has three integral mounting plugs. Three holes are bored into the cabinet side to receive the slide, which is merely driven in with a mallet. A groove dadoed into the drawer side rides over the slide.

TV extension

Television sets locked into a single position, usually flush against a wall, can be a problem. Sight lines may be obscured and the set is often too heavy for convenient movement.

A simple solution is to mount the TV on an extension chassis equipped with a swivel that enables it to extend out from its ordinarily fixed location. Easy swiveling allows the TV to be viewed from just about anywhere in a 180-degree arc.

You can make a sturdy extension by using a pair of Grant #3320 full-extension extra-heavy-duty slides and a flat ball-bearing lazy-Susan swivel. This slide may be either side- or bottom-mounted. With a side-mount installation, the load capacity is 250 lbs.; with bottom-mounting, it's 125.

The procedure is quite simple. For a bottom mount, attach the swivel to a board dimensioned to support the set. Drill a screw access hole in the board and attach the swivel to a second board. You then secure the slides to the bottom of the lower board and, in turn, to the base of the cabinet.

For side-mounted slides, use a boxed platform with side walls of 3½" minimum height instead of the flat lower board. This will provide a surface for attaching the slides.

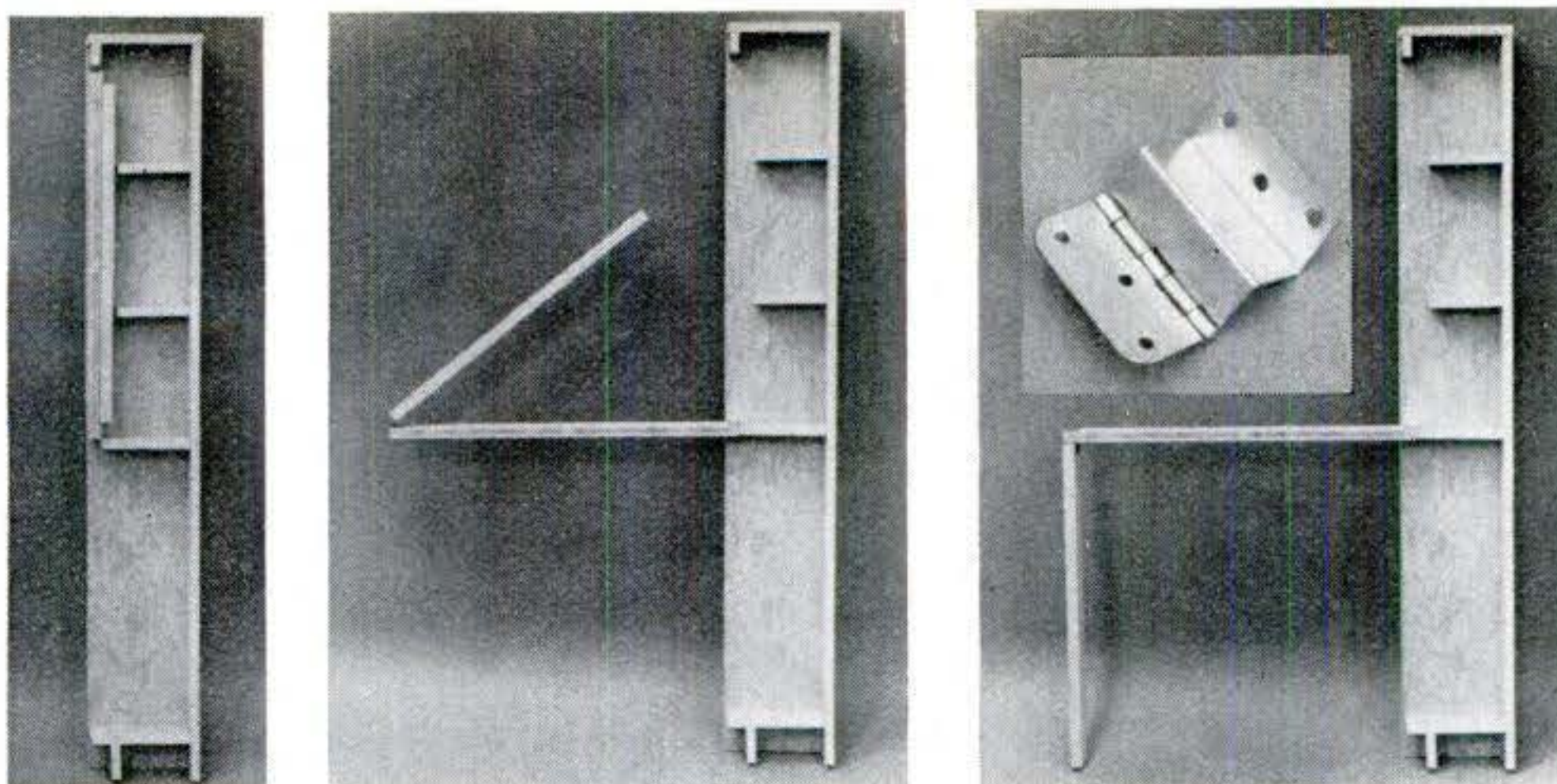
Flap stays

There's a new and better way to support drop lids and lift-up flaps: stays that use plastic and metal in a sliding action. This is a novel departure from familiar folding-knuckle-type hardware.

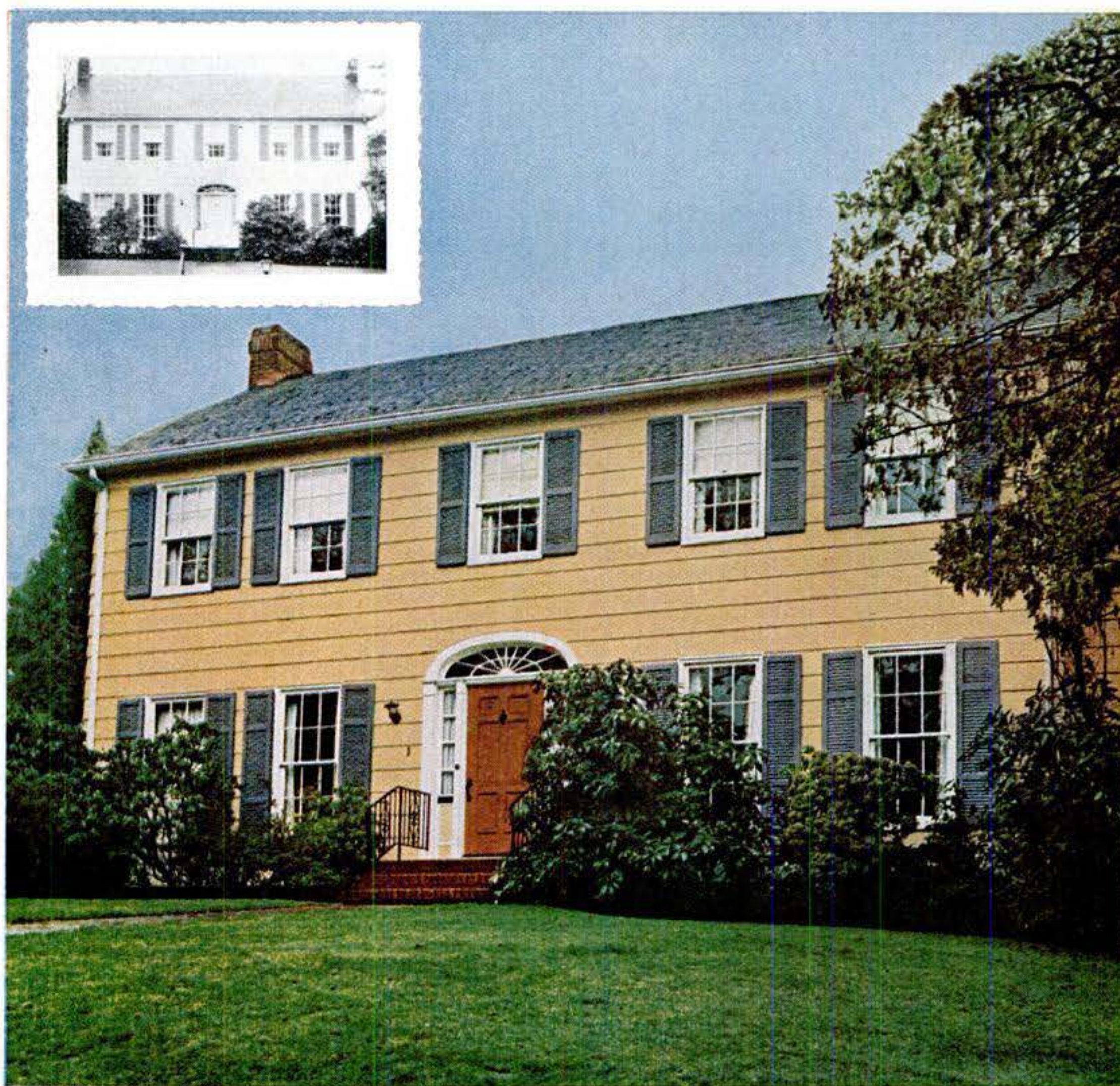
Some drop-lid stays are adjustable to allow a controlled rate of down slide. Such controlled braking action lets the flap down slowly and silently and prevents slamming and the tearing out of hinge screws.

A photo shows several styles of stays. The KLS 200 locks open automatically when the flap is lifted; a second lifting motion unlocks it. This support is useful for drop leaves on tables or folding shelves in kitchen, laundry, or shop. The Rotacam 250 is a very simple friction-type flap support that has no adjustments. It encounters resistance as the arm passes through a tapered slot. The 259A stay has an adjustment ring

Continued



Stain over paint?

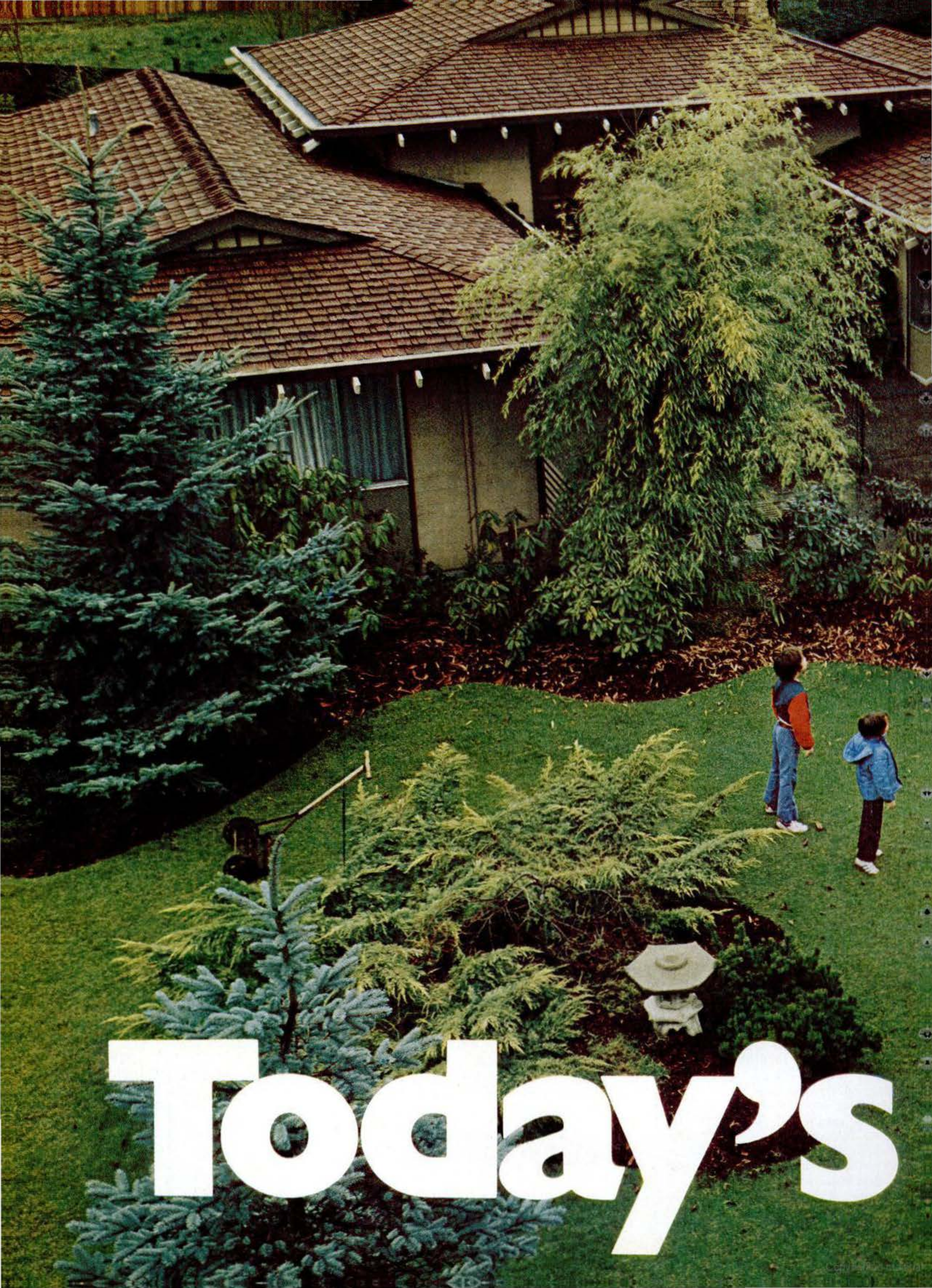


Now you can give your home the beauty of Olympic Stain, no matter how many times you've painted it before.

Olympic Acrylic Latex Stain hides paint beautifully with soft, solid color. It gives your home a rich mellow look, along with a tough acrylic finish that lasts for years. Cleans up easily with soap and water, too.

Olympic Latex Stain is also perfect for redoing any solid color stain. Available in 30 colors. Just follow easy label directions. For more information, see the Yellow Pages for your Olympic dealer, or write: Olympic, 2233 112th Ave. N.E., Bellevue, WA 98004.





Today's



The roof on this house is made of a new kind of non-wood shingle. The edges are thick and irregular, so they cast deep random shadows. The color is soft and muted, so it blends in naturally with the architecture and the surroundings.

Today's asphalt roofing shingles are among the finest products made in America. Some are made with a fiberglass base. All are handsome, durable, economical, and highly fire-resistant. And you have a wide spectrum to choose from, in a palette of colors to complement your home's exterior. Wherever you live in the West, today's roofing shingles fit in with any setting or architectural idea. Use them when building or remodeling.

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Hardware that travels

[Continued]

that permits you to control the braking action as much as the weight of the flap requires. The Regal uses a compression control rather than the direct-friction action of the others. An easily accessible rate-control knob adjusts infinitely for varied weights of flaps.

The Stanley V 772 heavy-duty folding-shelf bracket is recommended for large and heavy lift-up flap installations such as folding tables, knock-down shelves, and counters.

Two unique bar cabinet fittings are the Selby #207 and #215D cocktail-cabinet stays shown in our photos. Both automatically raise the top lid when the front flap is lowered. The 207 exposes the interior of the cabinet for full access. The 215D goes one step further: As lid and flap open, a glassware tray is simultaneously lifted forward and upward toward the user. The 207 has a built-in pin that stops the arm when the flap has traveled 90 degrees. The 215D requires the insertion of a short dowel in the cabinet side to serve as a stop at full open position. The moving tray is secured with screws to a shoulder on the lower horizontal members.

Hinges to know

Two hinges you should be familiar with are the swing leg and rising butt. The swing-leg hinge rotates 270 degrees, enabling you to construct a cabinet with a fold-out table that contains concealed legs. The legs, hidden inside the cabinet, are swung open when the table flap is dropped to horizontal. This hinge accommodates a 1"-thick leg and 3/4"-thick table flap.

The rising butt is an ingenious hinge that automatically lifts a door over thick carpeting or uneven flooring to eliminate jamming or scraping. The pitch of this hinge causes the door to close itself. It's used in matching left- or right-hand pairs.

A slide-out clothing carrier will improve the efficiency of your closet by making garments more accessible. A slight pull on the handle of the carrier slides your wardrobe toward you for easy selection. It can be readily installed under a closet shelf with four screws; several may fit the width of a closet.—Ro Capotosto

WHERE TO GET IT

The specialty hardware described here is often available at local hardware and building-supply dealers. Most sources carry Grant, HDI, and Stanley products. If a particular item is not stocked, it can be ordered. However, some of the special hardware items may be hard to find at retail outlets since they're usually marketed to the trade only. You can obtain these by mail-order. A major source of specialty hardware is Selby, 17 E. 22nd St., New York, N.Y. 10010; the company will send you a catalog for \$1, but since it's a wholesale house, it requires a \$25 minimum order. As for any hard-to-buy items we've shown or described here, A. Constantine, Inc., a leading woodworker's supply house, has agreed to make them available to PS readers. For prices, write the company at 2050 Eastchester Road, Bronx, N.Y. 10461.

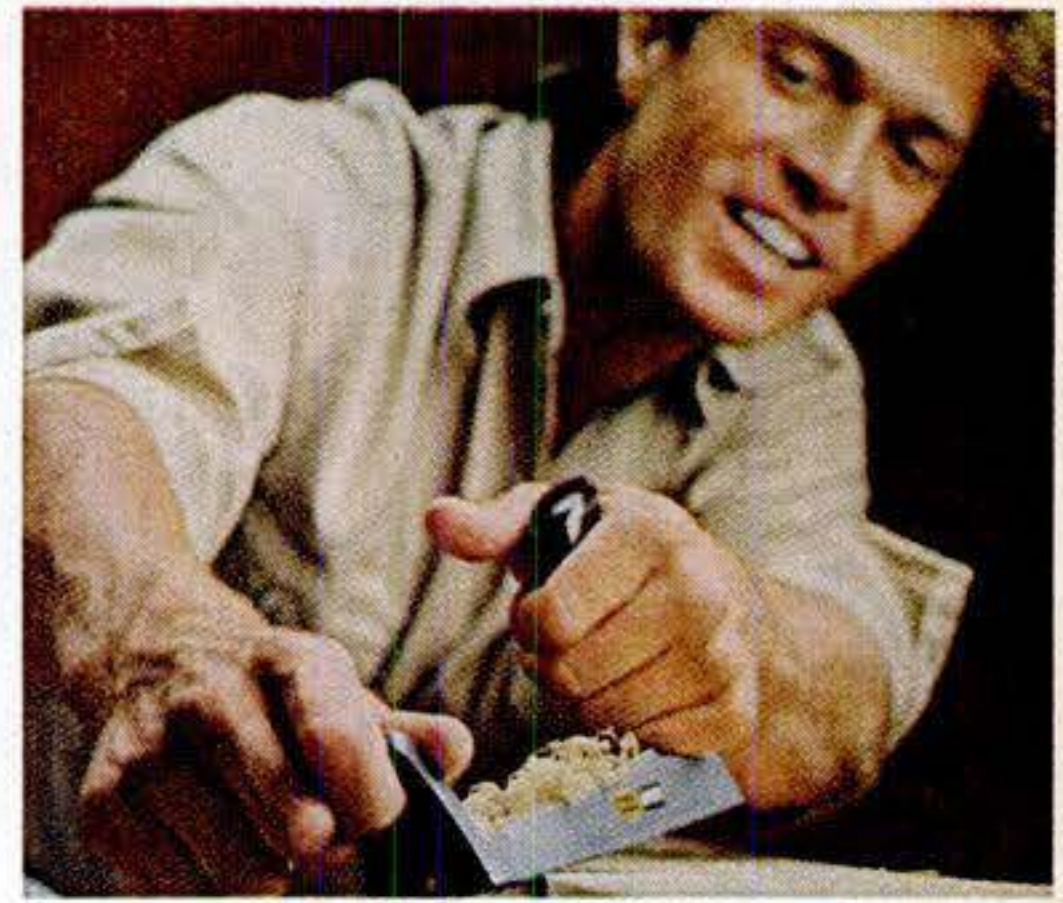
You can do it.



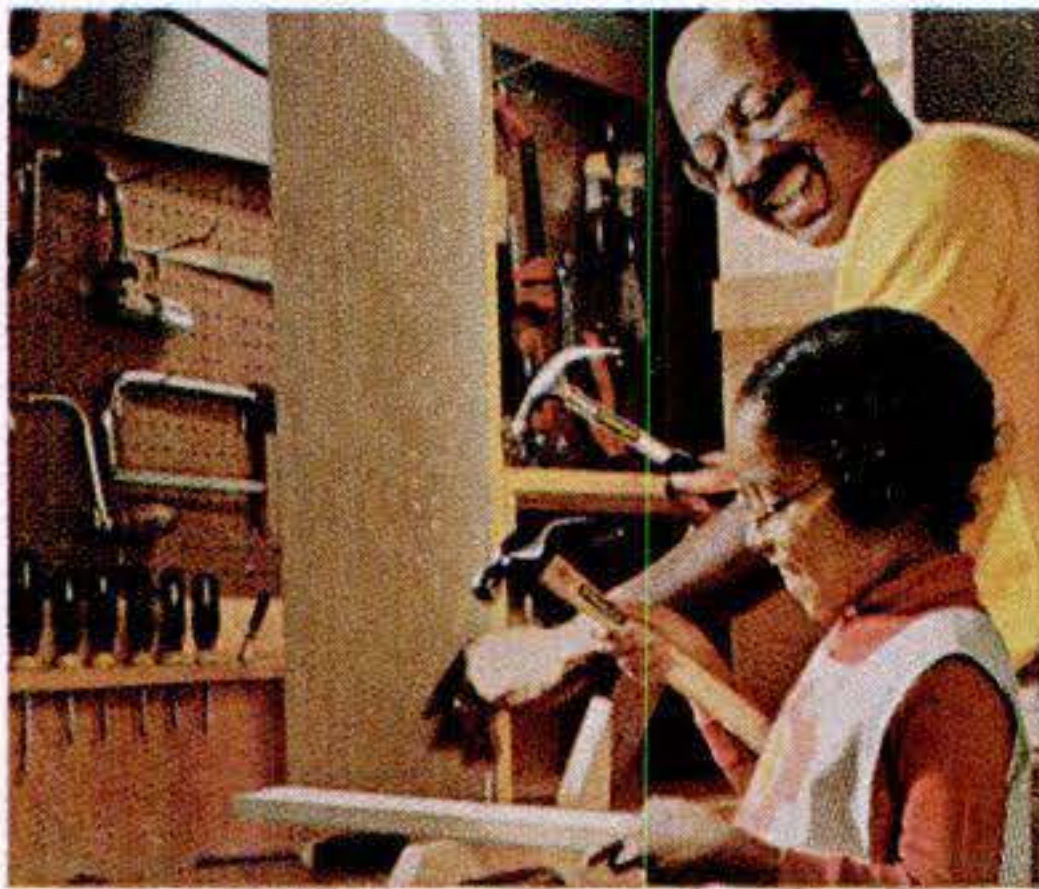
Measure it.



Cut it.



Plane it.



Hammer it.



Join it.



Shave it.



Level it.



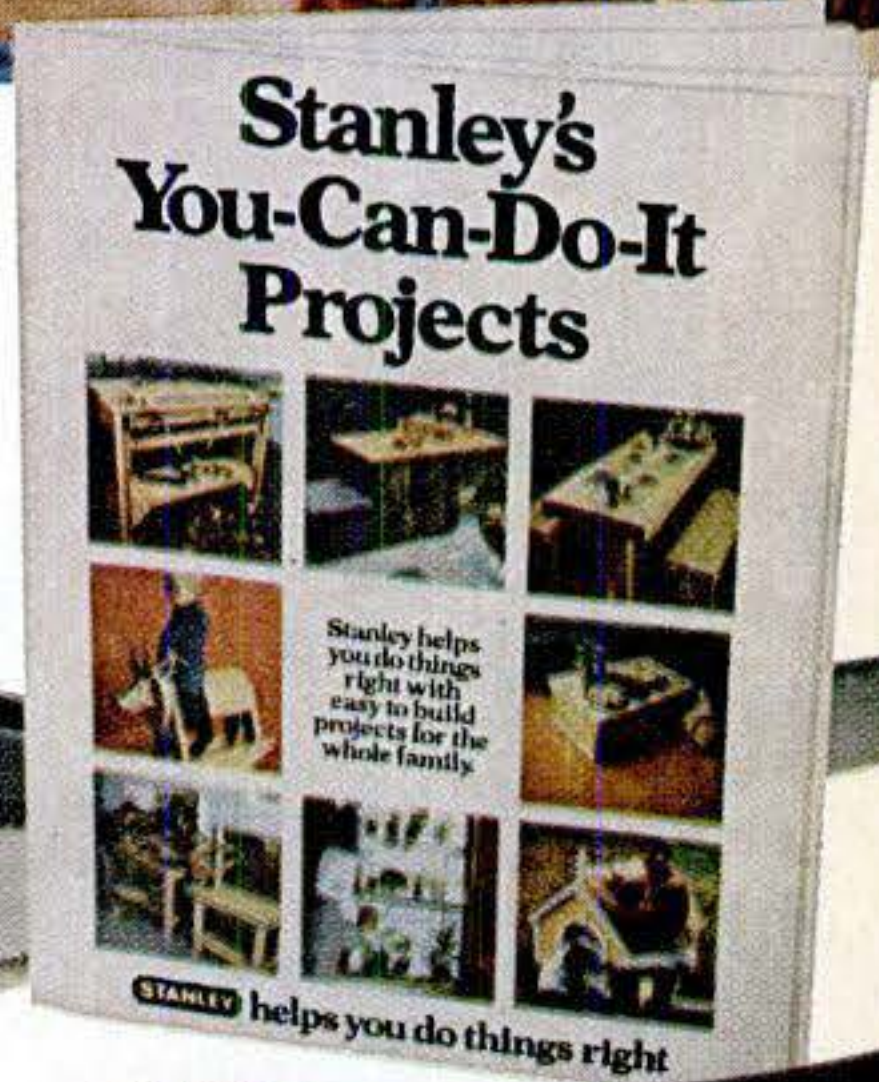
Sure, you can!



"I did it over a weekend," writes Bob Chambers, Seattle, Wash. "If I could do it, anyone can," says Al White, Rochester, N.H. And, from David Harris, Bowie, Md., "My doubts dissolved once I started. Just followed the Stanley plans set."

In letter after letter, everyone agrees — Stanley, the do-it-yourself company, has great plans for you. And the quality tools that help you do things right. As for this big "You Can Do It Projects" book, a \$2.00 value, get it for sending \$1.00 to cover handling to Stanley Tools, a Division of The Stanley Works, Dept. PS2, New Britain, CT 06050.

STANLEY
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Brushes clean easily with wash-up oil-base paints

Ask any homeowner to describe the paint of his dreams and he'd probably come up with a hybrid: He'd like the toughness, abrasion resistance, and great adhesion of a good oil-base urethane. At the same time, he'd want the soap-and-water cleanup and no-fumes safety of a good latex. Then he'd hasten to add that such a paint is impossible, because oil and water don't mix.

But such a paint is possible. In fact, two such paints are here. One is an oil-base house and trim paint; the other is an oil-base floor and trim enamel. Both are made



by Sapolin's new Hydrooil process.

The idea of a water-thinned oil base paint isn't new. As Sapolin chemist Larry Ridbecke explains, "People usually tried to saponify the oil, or make it partially into a soap." But there were problems of color change, of the paint remaining water-sensitive, and of stability and drying.

"Instead," Ridbecke says, "we

rearranged the oil molecule, which always has a given number of places on it that will accept oxygen and thus dry. Into some of those places we put a chemical that was compatible with the oil, that would accept water, and yet would not alter the oil so much that it wouldn't dry. Finally, we built this oil with the water acceptor into what we call a urethane oil."

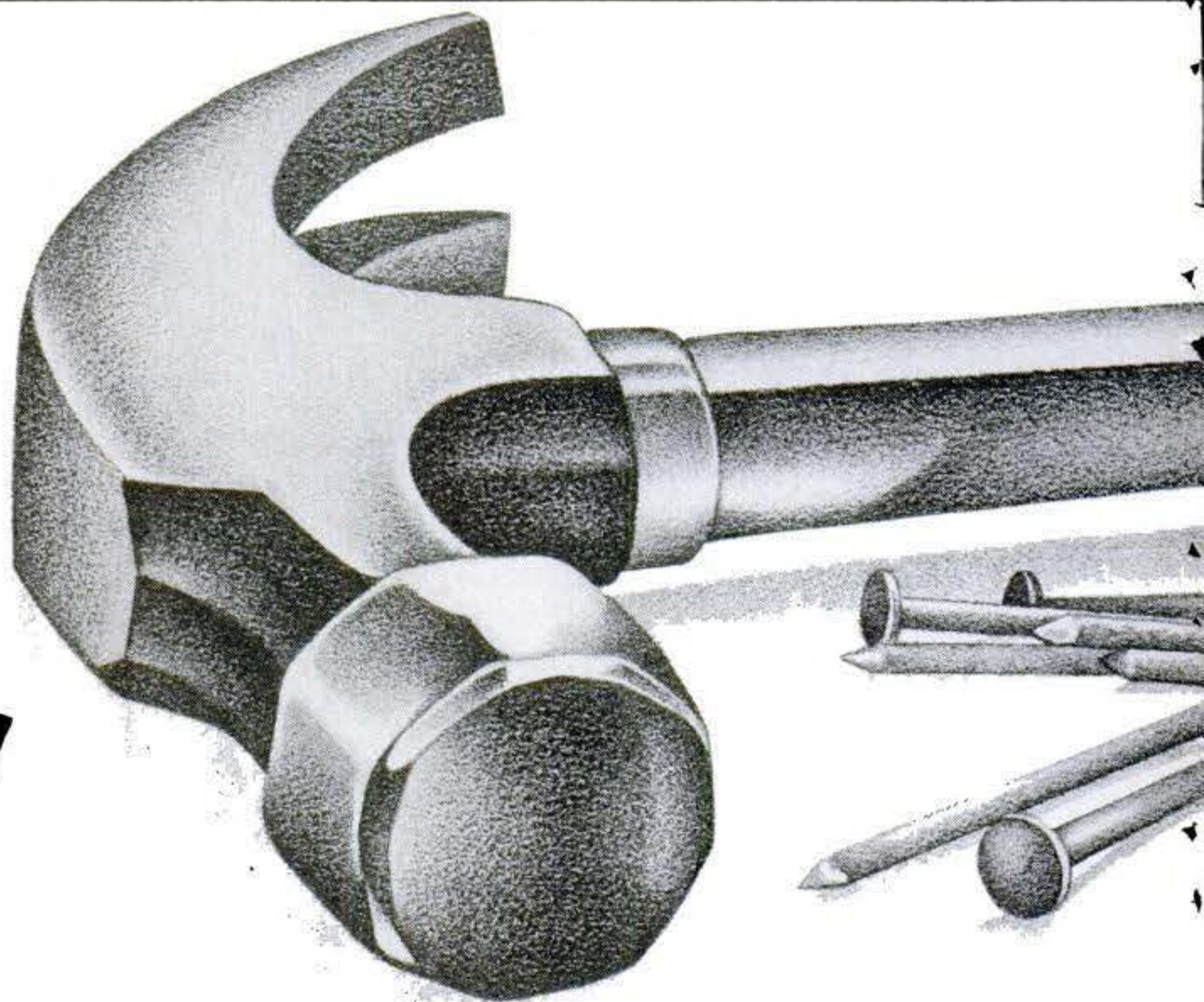
The result is an oil-based urethane paint that thins with water.

The white house and trim paint I tried handled beautifully. It brushed on smoothly and easily, and covered a dark gray house paint in a single coat when applied heavily, as called for on the label. It leveled out nicely, too, but didn't sag on vertical surfaces. And it washed off the brush like a dream with soap and water.

A sample of the floor and trim enamel was a disaster! It streaked and wouldn't wash off the brush. The reason? It was contaminated. A new sample worked fine.

Drying times for the paint are quite long. The label calls for 24 hours between coats of the house paint, and the same time lapse before subjecting the floor paint to traffic.—A. J. Hand

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If you use a truck to bring home the daily bread, you better have tires that'll work just as hard as you do.

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Tires for pickups, vans and whatever... that fit any truck you work and any way you work it.

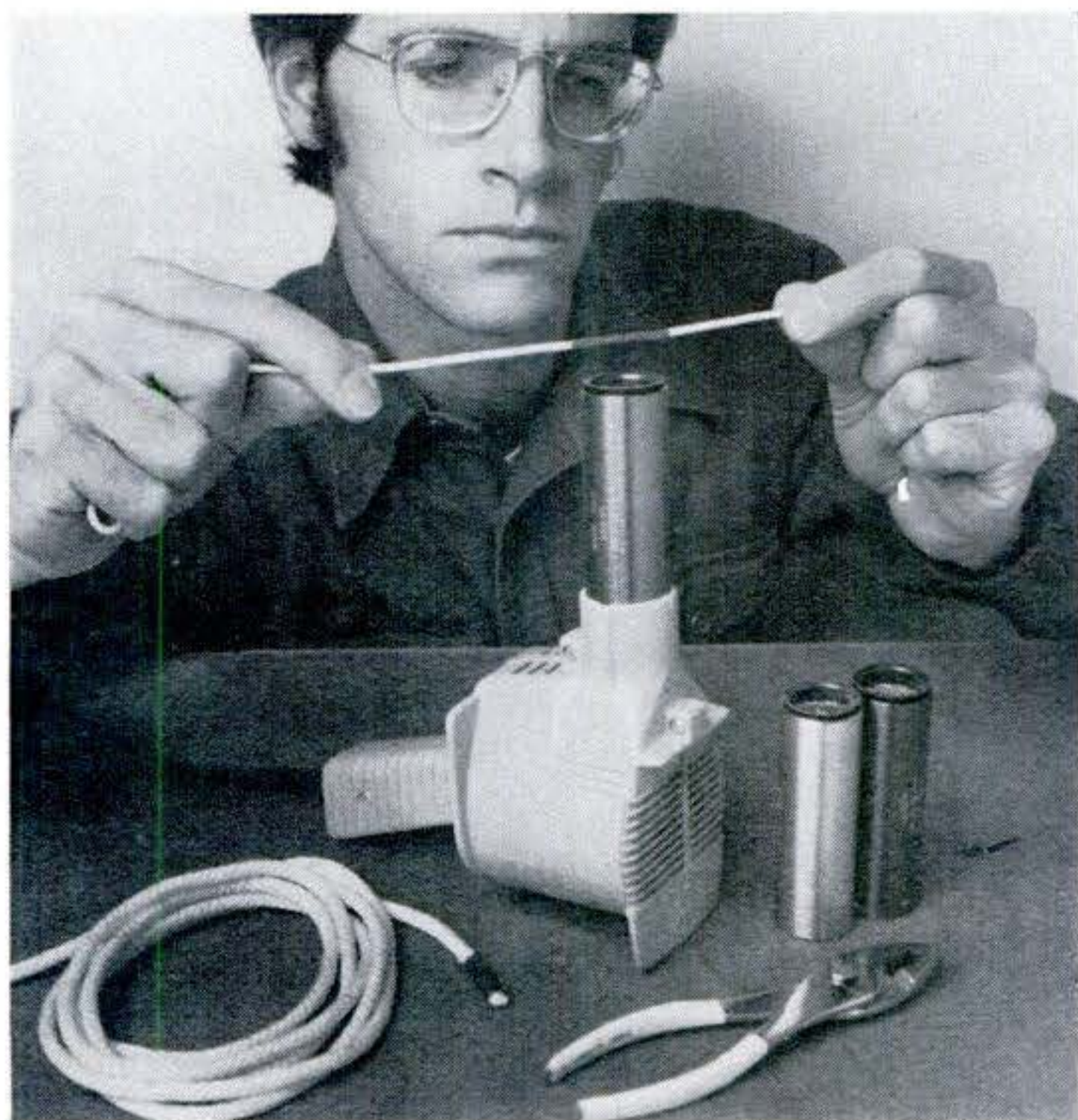
Naturally, choosing the right tire for your truck takes a man who knows his stuff.

Fortunately, your Firestone man knows just what it takes to put you right. At the right price, too. Prices begin as low as \$27.20. Popular 6.70-15 size Blackwall. Tube-type. Plus \$2.73 Federal Excise Tax, exchange.

And you can charge them on Master Charge, BankAmericard or Firestone's Revolving Charge.

After this kind of build-up, who would buy anything else?

Torch too hot? Reach for your heat gun



The flame from a torch is perfect for high-heat jobs like soldering. But when it comes to providing a source of low or medium heat, that same flame is out of place. It's hard to control, and is a definite fire hazard in many cases.

The right tool for the job is the heat gun—an electric hot-air blower. Industry has been using such a tool for years, but now Sears has taken the idea, made several nice improvements, cut the price, and put the heat gun in the hands of the homeowner.

First Sears replaced the usual heavy metal case with lightweight Noryl plastic. Next, to eliminate RF interference and the need to replace brushes, engineers designed a brushless motor to drive the blower. The blower itself is designed for low air flow, so you get less heat buildup in your work area.

The heating element is inside the gun's nozzle. Nozzles come in three different heat ranges, and are interchangeable. This allows you to choose the temperature you want, from 600 to 1250 degrees.

With the gun's 650-degree operating range you can handle dozens of jobs: Thaw frozen pipes or locks with no danger of overheating; soften acrylic plastics for bending; speed-cure epoxy glues; soften damaged floor tiles for easy removal and replacement.

One of the gun's slickest applications is shrinking plastic heat-shrink tubing. Since I got my gun I've used the tubing—also from Sears—to insulate electrical connections, cushion and insulate tool handles, even to whip the end of a rope.

The gun sells for \$44.95 with the medium-heat nozzle—about five bucks cheaper than most other heat guns. Optional high- and low-heat nozzles are \$7.95 each.—A.J. Hand

Firestone

Steeltex Radial	Town & Country Steeltex Radial	Trans/Sport	Transport 500 Wide Oval	Town & Country Wide Oval	Transport	All Terrain	All Terrain T/C
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SPRING
Home Value
Ideas

Readying yard equipment —do it right for a trouble-free summer

Now that spring has once again burst forth with buds and blossoms—and fast-growing grass and weeds—it's time to get your lawn and garden equipment tuned up.

If you performed the winter-storage procedures we discussed in last October's issue ["Yard-Equipment Storage"], you'll have an easy time getting your equipment ready for spring use; we've placed an asterisk (*) next to those steps you can skip. If you didn't do your chores last fall, you

Continued



Remove blade from a rotary mower to clean mower, sharpen blade, and allow access to oil drain. Don't hold blade by hand as you wrench: Wedge a scrap block between blade and housing to clamp blade.



Sharpen mower blade often; once a week is good practice since sharp blades reduce browning of grass. Don't try to remove a big nick; blend and work it out over several sharpenings. Replace damaged blades.



Check tire pressure and add air if necessary. Even a small spray-paint compressor is sufficient to inflate most low-pressure tires on mowers and tractors. Don't let tires sit half-flat between uses.

ANOTHER GOOD STEER FROM A TILT-WHEEL USER



Tilt-wheel Steering makes me feel like I'm being treated like a lady when I get in and out of my new Grand Prix.

*Barbara Taylor
Denver, Colorado*

Ms. Taylor, manufacturer's representative and boutique owner, is all business when she's on the road. But Tilt-Wheel Steering lets her enter and leave her car like a lady.

Convenience and comfort are what Tilt-Wheel is all about.

First of all, Tilt-Wheel moves up out of the way to help make getting in and out easier. Then, it adjusts to drivers of all sizes—short or tall, slim or portly. You simply select the most comfortable position for you.

You can even change the position of

the wheel as you drive, to make long trips more relaxing.

Some GM cars also offer Tilt & Telescope Steering. With it, you can move the wheel toward you or away from you, as well as up and down, for even greater comfort.

Tilt-Wheel Steering is available on GM cars, light-duty trucks and vans. See your General Motors dealer for a very comfortable demonstration.

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ARROW FASTENER COMPANY, INC.

271 MAYHILL STREET, SADDLE BROOK, N.J. 07662

Readying yard equipment

[Continued]



Don't over-tighten when replacing a spark plug. Torque the plug to the value specified by the manufacturer—about 10 lbs. should be plenty. Be especially careful on an aluminum head. If a torque wrench is not available, hand-tighten firmly.

will have a lot more work to do now.

The photos, captions, and instructions that follow tell you just what you need to do before you start up your machines. We've also included operating and maintenance tips that will keep them running reliably and efficiently all summer long. But before we get to that part, there were a few words of caution in our fall article that bear repeating here:

When working on gasoline-engine-powered equipment, remove the high-tension lead to the spark plug to prevent accidental starting.

When performing any maintenance on an electric tool, disconnect the power cord; also disconnect the lead to the battery and/or place the safety-lock switch in the lock position.

Be sure the engine or motor is cool before you clean it. Cold water applied to a hot engine can crack the metal. Also, some degreasers are flammable. Never immerse engine- or motor-powered equipment in water.

General-care procedures

These procedures should be followed before the initial use of all tools (and also after each use):

* Check all bolts, nuts, screws, and other fasteners; tighten, if required. Replace any fasteners that are severely rusted. Check that all toe guards, safety switches, and chute deflectors are undamaged and in place.

* Thoroughly clean the outside of the tool. Scrape off dirt, dried grass clippings, and other muck with a wooden stick or a plastic scraper. Do not use a metal tool; it will scratch the surface and dirt will collect more readily. Use a 1/4-inch pointed dowel to reach into narrow places, such as between cooling fins. Remove any remaining dirt with a stiff-bristle brush, a rag, and a solution of soap and wa-

ter. Stubborn grease and oil can be removed with a degreaser (denatured alcohol works well). Do not use gasoline, lacquer thinner, paint thinner, or dry-cleaning fluid on plastics (many household cleaners also contain chemicals that damage plastics).

Fertilizers increase the rate of corrosion. Wipe all equipment that was exposed to fertilizers or other garden chemicals with a damp cloth. Let the equipment dry thoroughly.

* Occasionally apply a light coat of automobile wax to painted metal and plastic parts of the tool. Buff with a soft dry cloth. The wax will help protect the surface and prevent dirt accumulation.

* Check all moving mechanical parts for lubrication, applying a light machine oil unless a grease nipple is provided. With heavy equipment such as riding mowers and yard tractors, consult your owner's manual for greasing tips. If not available, check the unit for grease nipples and give each a squirt with a small gun. If you didn't do a thorough lube job in the fall, do it now.

Sharpen (or replace) cutting blades when they become dull (see photos). A sharp tool cuts easier, reduces the load on the machine, and is safer because it works more efficiently.

Store the equipment in a clean, dry, weather-protected area away from fertilizers and other garden chemicals. Cover it with a clean cloth to keep off dust.

Cleaning and corrosion-proofing should be regularly done on all tools. Beyond that, procedures for preparing equipment for its initial use and for proper care and maintenance during the season differ according to the power source of the tool.

Gasoline-powered equipment

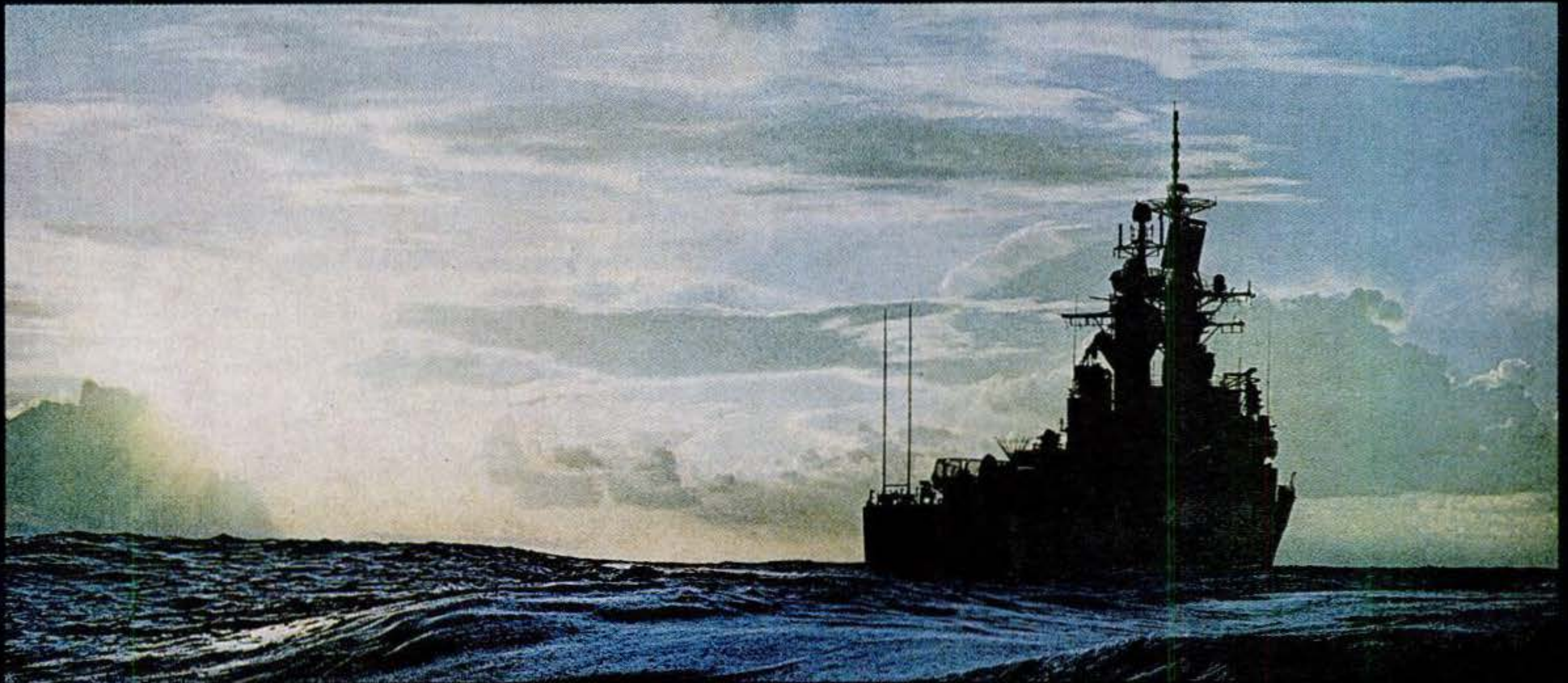
* *Four-cycle engine only.* Fill the crankcase with new oil. Here's how: First run the engine until it reaches operating temperature. This heats the oil and sludge in the crankcase, making for more complete engine-oil draining. With the engine off and the high-tension lead disconnected, remove the drain plug and drain the oil from the crankcase. Loosen the oil-fill cap to provide an air vent. Position the engine so that the drain hole is at the bottom for complete drainage. Reinstall the drain plug. Fill the crankcase to the full mark with new oil and replace the cap.

Fill the fuel tank with new fuel. (Properly mix fuel and oil for a two-cycle engine.)

Clean the air cleaner (or, if damaged, replace it with a new one). Filters may be made of paper, felt, fiber, metal, foil, or hair. They are classified as dry filters, oiled filters, and oil-bath filters. Here are some

Continued

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NAVY. IT'S NOT JUST A JOB, IT'S AN ADVENTURE.

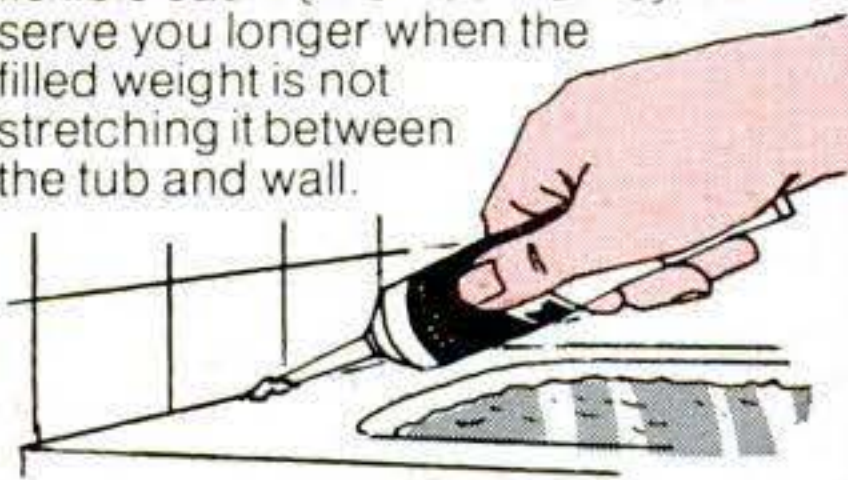
HANDY IDEAS FROM BIG RED

A handy man to have around the house.



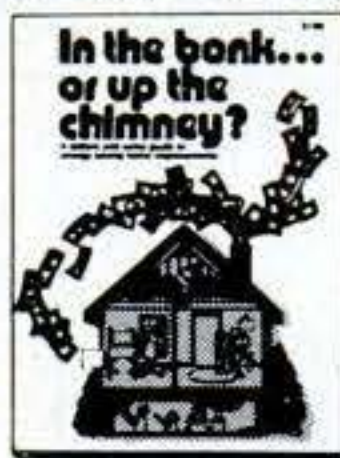
More home fix-up tips from the pro.

Fill the tub before you caulk. (Get in if you can, too.) Then, when the tub is empty, it'll rise slightly and squeeze the caulk. Even a good flexible caulk (like Red Devil's) will serve you longer when the filled weight is not stretching it between the tub and wall.



Save money when you save energy.

This new 72-page Energy-Saving Book has dozens of do-it-yourself energy-saving tips that can save you hundreds of dollars. The cost is only \$1.25 plus 50¢ postage and handling. Send check or money order to: Save Energy, Dept. F2, Box 310, Maplewood, N.J. 07040.



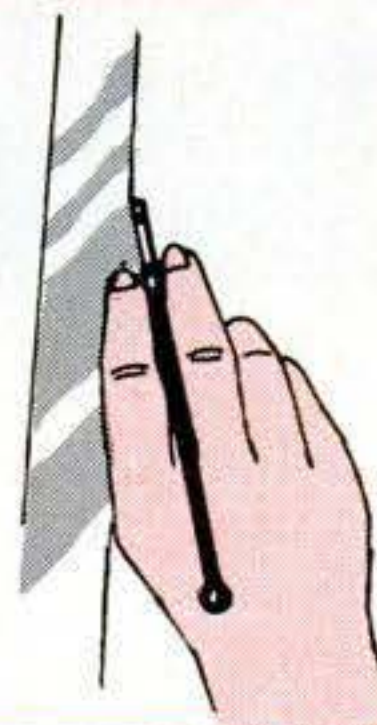
Give your new bathroom or mosaics a decorator look.

Add a touch of color to the grout before you put it between the tiles. Just mix acrylic paint tint (from wherever you buy paint) with Red Devil Instant Tile Grout and see the exciting effect it creates.



You don't cut glass with a glass cutter.

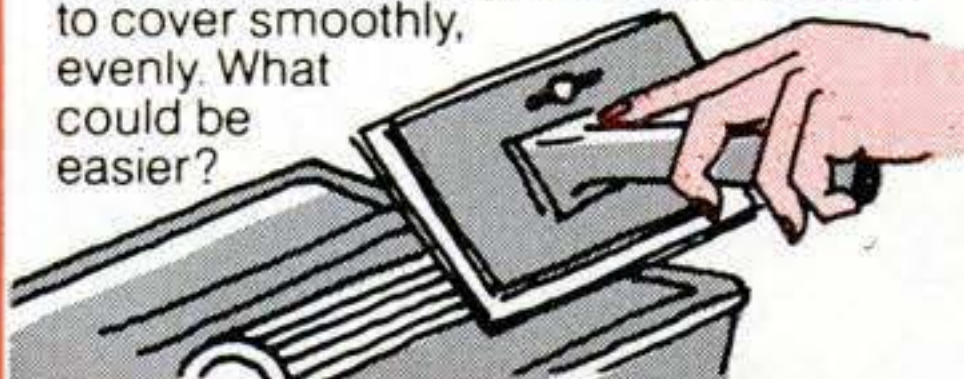
You score it to release surface tension. So don't press too hard or go over it a second time. Hold your Red Devil cutter between the index and middle fingers as shown, (a drop of oil on the cutter helps, too). Then, you've got the score.



A putty knife is not a scraper. And vice versa. Putty knives (for spackling walls and puttying windows) have flexible blades to smooth-on the material. Scraper blades are stiff, to keep the edge against the coating being removed. To do these jobs right, you need both tools (both from Red Devil, of course).



Go easy on the paint with your pad painter. If you let the pad soak up too much paint, you won't get the best possible results. That's why Red Devil has a patented metering tray designed especially for pad painters. It puts on just the right amount of paint to cover smoothly, evenly. What could be easier?



Red Devil has hundreds of things to make your home fix-up easier. Look for them wherever you shop for home-care products. And for best results, always follow directions on the package.

Red Devil

UNION, N.J. 07083



Readying yard equipment

[Continued]

general instructions on how to clean the various types. (Follow your owner's manual for specifics.)

Dry filters are cleaned by tapping them; some types can be washed in water or a solvent.

Metal mesh or foam pads to which oil is applied are cleaned in kerosene or in detergent and water, then dried. The oil filter is then saturated with oil and the excess removed.

Remove the oil cup from the bottom of an oil-bath air cleaner and discard the old oil. Clean the oil cup, filter, and cap in kerosene or detergent and water. Dry the parts. Refill the cup to the mark with oil (usually SAE 30).

Check the gasket at the air filter and replace if damaged.

Remove the spark plug and inspect it for a broken insulator, badly burned electrodes, electrodes worn thin, or other damage. If you find any of these problems, replace it. If the plug is not damaged, wire-brush the threads. File the oxide and scale from the electrodes, using a pointed file. Check the electrode gap and reset it to the manufacturer's specs by bending the side electrode. Clean the copper gasket with steel wool. Wipe the plug, gasket, and the plug seat with a clean cloth dampened with solvent. Replace the gasket and spark plug, and torque the plug to the value specified by the manufacturer (see photo).

Remove the fuel filter (and fuel bowl, if applicable). Swish the parts in a solvent until clean, then let the filter dry. Check the gasket and replace it if necessary. Reinstall the filter. Clean the fuel-tank vent cap as you did the fuel filter.

Carburetor and governor settings are factory-adjusted and should not be readjusted unless disassembled. Improper adjustment of a two-cycle engine carburetor can result in insufficient lubrication to the engine, which can cause engine damage. A high governor setting can cause engine overspeeding with resulting engine damage. Some manufacturers are building carburetors without any adjustment needle valves.

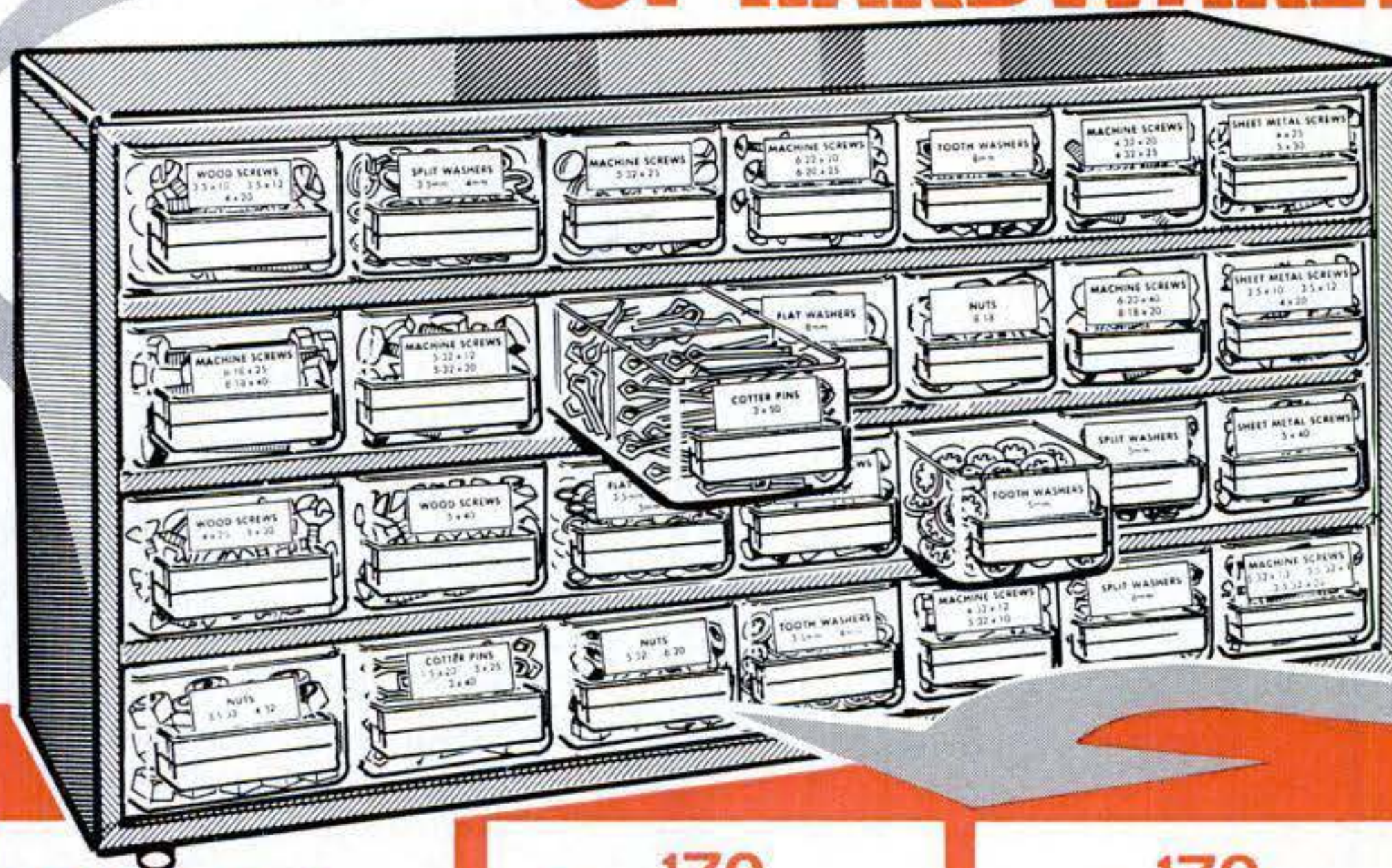
The box on page 154 details the procedures to follow to keep your gasoline-powered equipment running well throughout the summer.

Electric-powered equipment

If you performed the proper storage procedures for your electric-powered equipment last fall, it is ready for use. Therefore all of the following instructions have the asterisk (*). Be sure to check your owner's manual for directions regarding motor and bearing lubrication. Some motors are permanently lubricated and sealed at the factory.

* If your motor requires upper-
Continued

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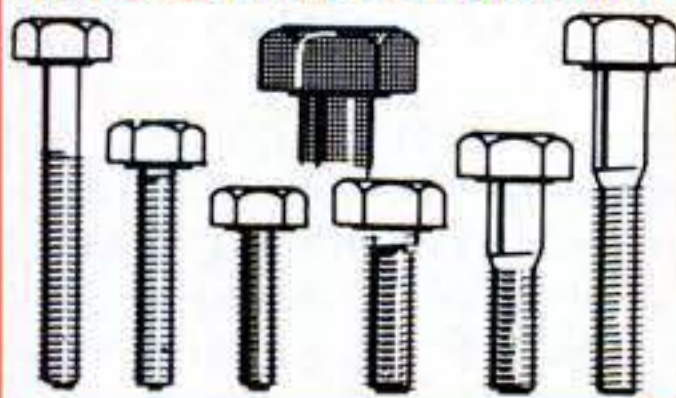


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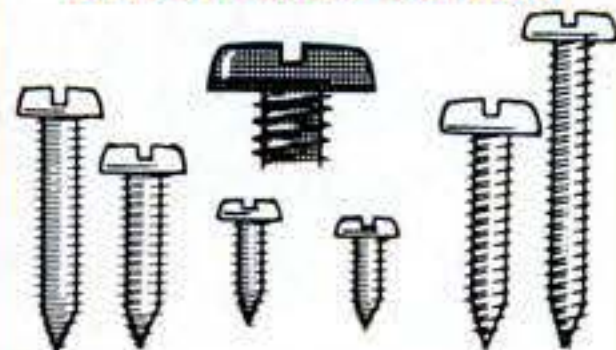
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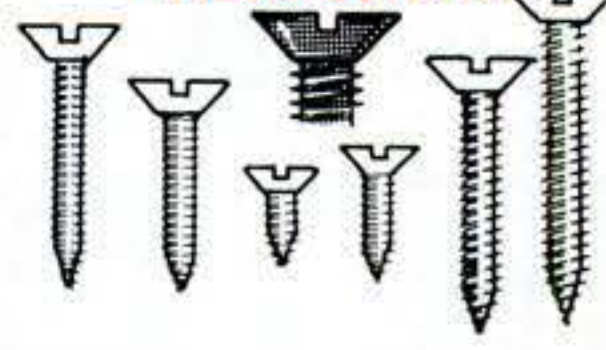
405 Machine Screws



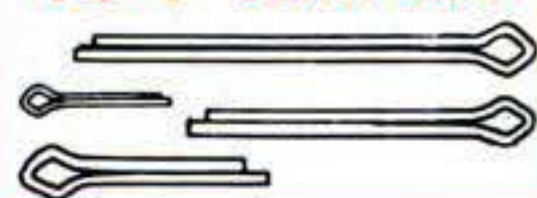
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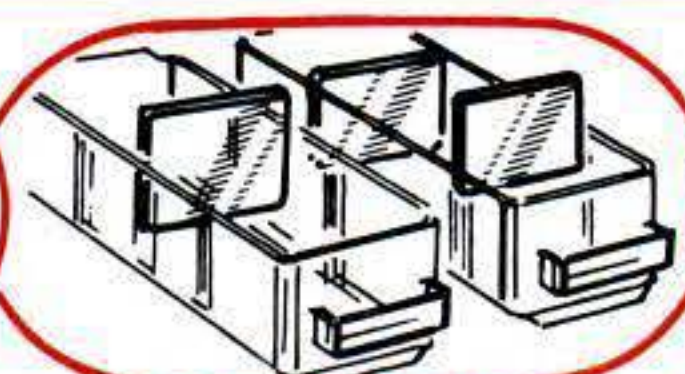
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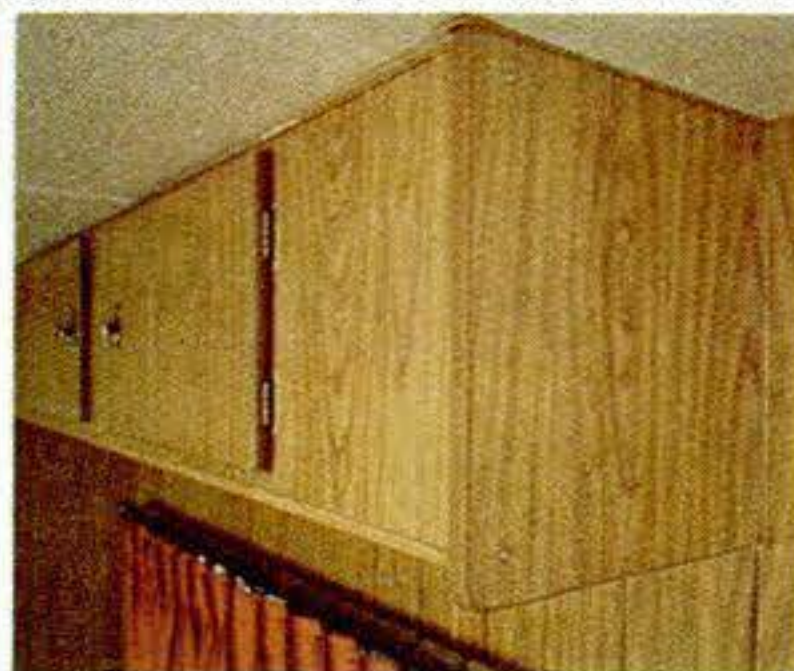
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Readying yard equipment

[Continued]

motor-bearing lubrication, remove the motor cover. Place five drops of machine oil (SAE 20) in the felt reservoir at the top of the motor. Replace the motor cover.

* On lawn mowers, lubricate the blade-shaft bearings located under the deck, if required. First clean the area around the oil-reservoir screws. Remove the screws, fill the reservoirs with machine oil, and replace and tighten the screws.

* Inspect your electrical power cord. If there are nicks in the insulation, wrap the nick with plastic electrical tape. If the insulation is cracked and frayed at the plug or receptacle, cut off the bad section of cord and connect the remaining part to a new plug or receptacle.

Battery-powered equipment

Batteries should be charged only in well-ventilated areas away from all open flames, electrical sparks, cigars, and cigarettes. Gases produced while charging a battery can be explosive.

Charge the storage battery prior to use, following the manufacturer's instructions. If the charger operates on a timer with a "maintain" position, charge until the end of the cycle, when the timer will have reached the "maintain" position. Leave the battery on the maintenance charger until the next time the equipment is used (but not for extended storage unless the manufacturer recommends it).

After charging, check the electrolyte level. Add clear water if necessary to bring it up to the full mark. Tighten the caps securely.

Unplug the battery from the equipment before cleaning it or adjusting the equipment. With the battery in place the machine can be placed on its side for a short period of time for cleaning and adjustment. But don't leave the battery on its side more than 15 minutes or electrolyte will escape through the vent tube.

* Inspect the battery terminals and connections for corrosion. Clean them with a wire brush or steel wool. Wipe away any foreign matter with a clean, dry cloth. Corrosion and dirt on the top of the battery can be cleaned off with a mild solution of baking soda and water; be sure that the vent plugs remain tightly in place. Brush the solution on and allow it to work a few minutes. Then rinse it off with clear water and wipe the battery dry.

* If your equipment requires motor lubrication, unplug the battery and remove the motor cover(s). Place four drops of motor oil (SAE 20) in each screw hole. Replace the motor cover and tighten the screws.

To keep your battery-powered equipment running reliably all summer, recharge the battery immediately

Continued

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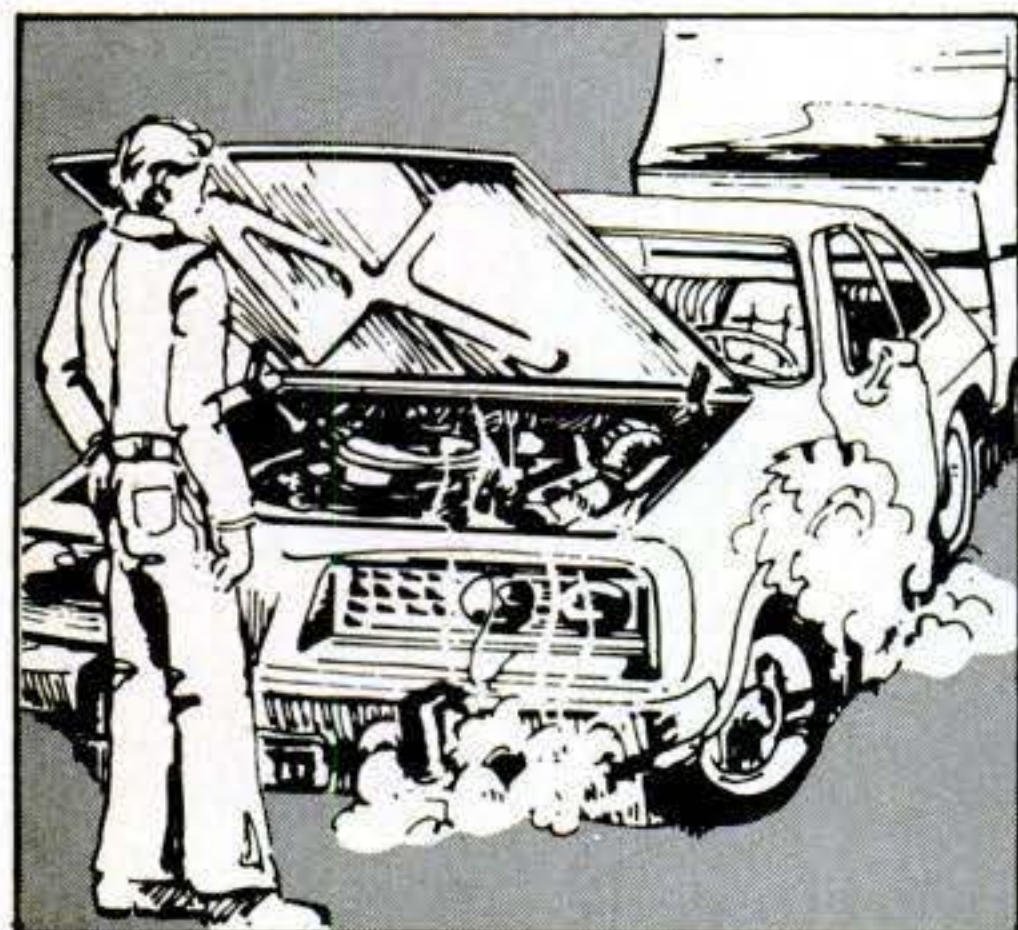
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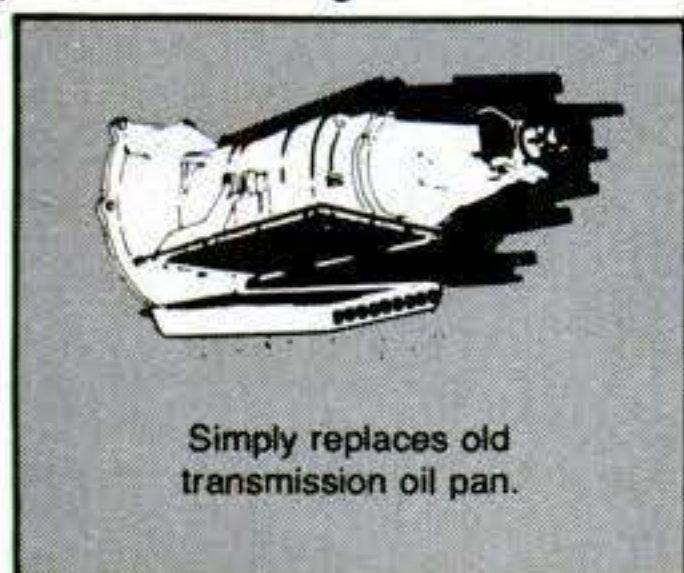
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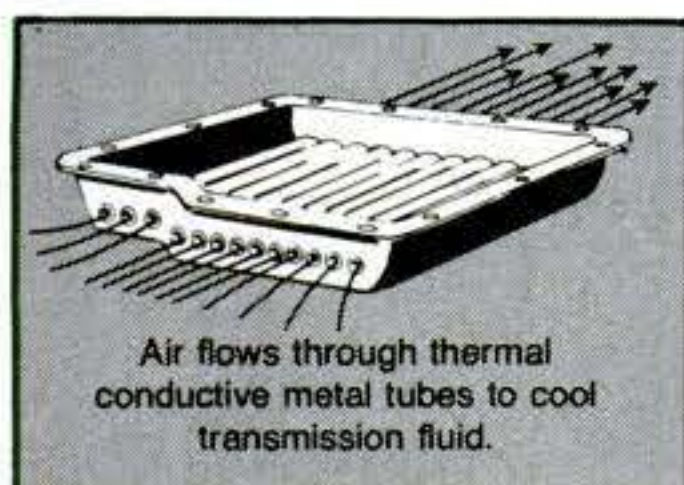
Your performance car, off-road vehicle, four wheeler, van or RV is designed to pull its own weight...just its own weight. When you demand more performance from your transmission, it can heat up—cause expensive repairs—even shorten its running life. The solution is simple: an Integrity Oil Cooler. It's easy to install, has no moving parts...nothing to go wrong.

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Readying yard equipment

[Continued]

after each use. Keep it on "maintain" charge if the equipment is to be used within a week or two.

Battery-pack equipment

One day prior to your initial use of a battery-pack tool, wipe off any oil that you put on it for winter storage and charge the battery. If possible charge it where the ambient temperature is about 75° F. Do not charge it where the temperature is below 40° or above 105°. Charge it indoors, out of the weather. Be sure to use only the specific charger designed for the tool. Attach the charger to the battery first, then connect to house power (115-120 VAC). Charge at least for the time required; it doesn't matter if the charging time is exceeded. In fact, some manufacturers recommend that you store a battery-pack tool plugged into its charger throughout the trim-

ming season so that the tool will always have a full charge. But never use the tool with the charger as its power source.

The battery pack should be recharged whenever the tool starts to lose power and begins to labor.

After each use, clean the tool by applying a full-strength household cleaner to the cutting blades. After 10 minutes, scrub the blades with a stiff brush. Rinse them in a bucket of warm water. Dunk the blades only; do not get the motor housing wet. With the blades in water, run the motor for about 10 seconds, then dry them with a clean cloth. Spray the blades with a dry lubricant to decrease the frequency of cleanings.

Recharge the battery pack and store the tool in a dry place where the temperature won't go below 40° F or above 120°.—George R. Drake

Operating and maintaining gasoline-powered equipment

Engine starting:

1. Place the equipment on level ground.
2. Check and fill oil (four-cycle engine) and battery water (electrolyte) to proper level.
3. Fill the fuel tank with clean fuel (properly mixed with oil for a two-cycle engine).
4. Open the fuel shutoff valve and the gas vent-cap shutoff valve.
5. Clear away all obstructions (mowers should not be started in high grass).
6. Close the choke.
7. Prime the engine if necessary.
8. Set the throttle to recommended starting position.
9. Slowly crank the engine over a few times to get fuel into the carburetor.
10. Turn on the ignition and crank the engine. If the engine doesn't start, open the choke partway and try again.
11. Once the engine is running, open the choke and let it warm up about two minutes at idle speed before applying full power or load.

Engine operation:

1. Run the engine at the recommended speed.
2. Do not overload the engine. Let the equipment do its job, but when the going gets tough, ease off a bit to avoid overloading. (For example, cut one-third of the way into high grass and two-thirds of the way into already cut grass if the grass is so high that it overloads the engine. Or raise the blade height and mow twice.)
3. Avoid long periods at idle or in slow-speed operation.

Engine shutoff:

1. Remove the load from the engine.
2. Set the engine at idle and let it run for about two minutes. This cools the engine by gradually reducing the thermal stresses on the parts.
3. Turn off the engine.
4. Close the fuel shutoff valve.

During the growing season, follow the schedule below. Reduce maintenance intervals for equipment used in a dusty environment, such as tillers and garden tractors.

Preventive maintenance through the summer

Hours of operation	Maintenance required
Each gasoline refill (2-cycle engine)	Add proper mixture of oil to gasoline.
After every use	Clean off dirt, grass clippings, etc. Check engine oil level. Refill to full, if necessary.
3	Check engine oil level and fill to full mark, as required. Resharpen rotary-mower blades.
10†	Clean carburetor air cleaner.
10	Check tightness of all hardware, structural soundness, and sharpness of blades, teeth, and so on. Lubricate non-engine parts (except plastic bearings). Adjust belt tensions.
25	Clean fuel filter, fuel-tank vent cap, and crankcase breather (4-cycle engine).
25††	Change the engine oil.
50 to 100	Replace spark plug, regapping it properly first. Check compression by disconnecting spark-plug high-tension lead. Pull starter through a cycle. If the engine spins easily, there is little if any compression and it probably needs servicing; but check manual or dealer to see if your engine has a decompression feature.
Monthly†††	Check electrolyte level in battery; fill with clear water, as required. Clean battery terminals.

†Clean each 3 to 5 hours if used in a dusty environment.

††Change the crankcase oil after the initial 2 hours of operation, then every 25 hours.

†††Check biweekly in hot weather.

In thirty years, you can give it to your grandson.

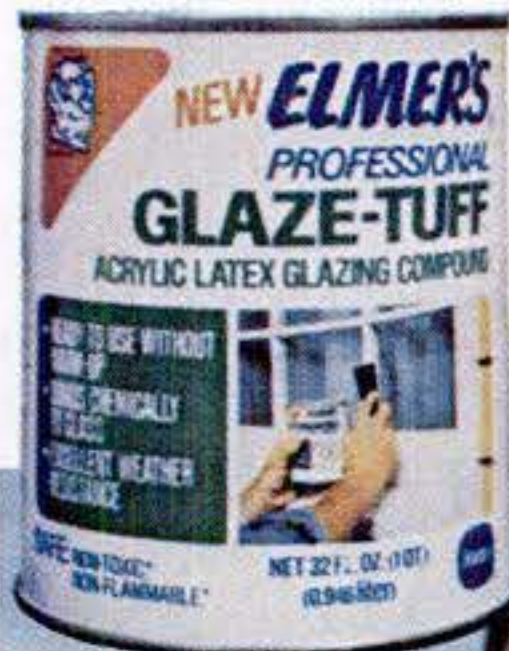
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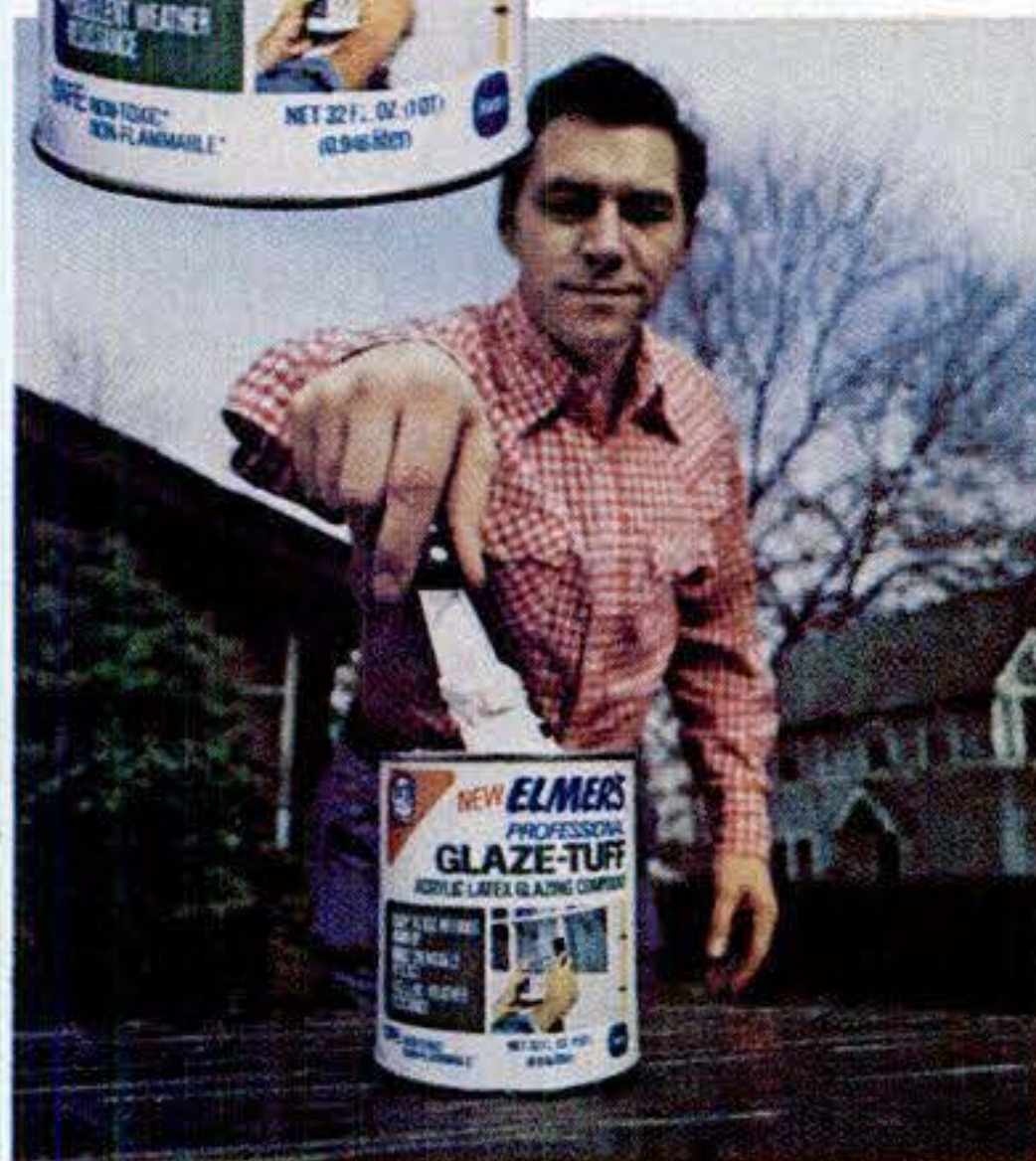


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SHOP TALK

By AL LEES



HI bookshelf (cont.)

Reviews of six of the books across the top of this photo filled my entire column in last month's Home Improvement issue. Space ran out with *Fences*—so here are evaluations of the remaining half-dozen titles:

● *Barns, Sheds and Outbuildings* (\$6.95, Stephen Greene) is perhaps of less practical interest than its nostalgic companion volume, *Fences*, since there are many modern books on frame construction (they're listed in a bibliography added at the back of this 240-page reprint), and also because there's little need, in today's average yard, for an ice house, corn crib, root pit, or smoke house. And the book, fun as it is to leaf through, has no construction details.

Now, the five titles in the front row:

● *The Sauna Book* (\$7.95, Harper & Row) should—by all that's sacred and sensible—be the last word on the practice and lore of sauna bathing, but I'll bet that even as I'm typing this at least three other sauna books are in preparation somewhere. It's hard to see what co-authors Tom Johnson and Tim Miller have left anyone else to say. If you're a sometime sauna enthusiast like me, you'll find their musings and pronouncements a constant delight. I'd give them only one argument. In a sidebar, they're at pains to reject redwood as a construction material for a stove room. (Anyone who's sweated in a redwood sauna knows that no other wood gives the same welcome.) In fact, these authors call for a conservationists' boycott of *all* use of redwood, terming it an endangered species. Such uninformed emotionalism mars no other aspect of this zestful book, however. The construction tips are sound. The lively pencil sketches are enough to make you want to dive nude into a snowbank.

● *Complete Home Plumbing and Heating Handbook* (\$12.95, Arco) strives diligently to live up to its ambitious title. The compiler is that prolific producer of mammoth encyclopedia-like how-to books, Jeannette T. Adams. And, at 672 pages, this is one of

her most exhaustive. (The appendices and index alone run 50 close-packed pages.) There's a lot here for the home improver, including a couple of chapters on planning bathrooms and kitchens. But, as with other of her books reviewed here earlier, Ms. Adams just doesn't know when to stop. She tosses in all kinds of irrelevant information, often reworked from her previous books. How can flashing or wall-framing details belong in a book of this title? And often, in cramming in too much data, she can't trouble to update it. In discussing gutters and downspouts, for example (they qualify as plumbing, maybe?), she seems not to know that vinyl exists. Yet, as an article in our April issue noted, vinyl's fast becoming the leading material for guttering systems. It's better, however, for a how-to book to overreach than to skimp—and the 500 illustrations are particularly helpful.

● *Your Own Backyard* (\$14.95, Crowell) is the *biggest* book of the lot, with over 330 large-format pages and a thousand illustrations, and I have reasons—not wholly objective ones—for judging it the best. It's a compendium of outdoor home-improvement projects, from simple (birdbath fountain) to complex (double-deck gazebo), and I can recommend them all as "construction-tested" since they are all adapted from the pages of *Popular Science*. In co-editing this collection with former Editor-in-Chief (retired) E. V. Heyn, I organized projects and instruction from our top contributors into nine sections (Storage Buildings, Decks and Patios, Outdoor Lighting, etc.). What sets this collection apart from other outdoor building books is the same thing that distinguishes PS projects from those in other magazines: the thoroughness of the how-to. Skilled home craftsmen may not need all the data we supply, but it's there for anyone who does. As with an earlier collection of PS plans—*Woodworking Projects for the Home* (\$12.95, Harper & Row)—I find it personally gratifying that the fine work of our contributing craftsmen has been given permanence within hard covers. *Backyard* is the PS Book Club Sept. selection.

● *Goodbye to the Flush Toilet* (\$6.95, Rodale) is a fat paperback passed along to me by former-staff-turned-freelance Ed Moran, with a note attached: "Published too late for my January 'Waterless Toilets' roundup, this is without doubt the best source for the layman." Though I can't match Ed's expertise in this field (which he

researched thoroughly for his article), I share his enthusiasm for this new book and recommend it to anyone considering an installation of a new john. You do have choices other than the wasteful conventional toilet, as the book's subtitle suggests: "Water-Saving Alternatives to Cesspools, Septic Tanks, and Sewers." The mere fact that these three terms have negative connotations for everyone except sanitation engineers confirms that present household waste disposal remains an unpleasant problem. Frankly, I've never accepted the notion that dragging the outhouse back inside is an attractive or progressive solution, either—even when it's redubbed a "biological recycling unit" and the odors are power vented out the roof. Still, I found this well-edited collection of articles on the alternatives, each written by an expert in a specific field, persuasive enough that if I were not satisfied with my present aerobic system, I'd probably overcome my innate distaste and go to a composter. Anyway, at the back of this book is a valuable listing of sources for all types of water-conserving hardware. I was happy to see as simple and direct a device as toilet-tank dams included, since that indicates the book's concerns are honest and not obsessive. Most of us will stick with the hardware we've already got but will want to improve its water-use efficiency. Tank dams (and reduced-flow faucets and showerheads) are effective, as we reported last August ("PS Tests Bathroom Water-Savers") and as I can attest after a year's use in my own home.

● *The New Homeowner's Illustrated Handbook: A Do-It-Yourself Guide to Problems That Are Sure to Occur* (\$10.95, Parker) doesn't strictly belong in this company, since its focus is more on repair and maintenance than home improvement. But if you need a quick reference source to point you toward solutions to common malfunctions in your home and appliances, this book may meet our criterion of enriching your lifestyle. It only points though: It's even skimpier in instruction than those familiar "home tip" newspaper fillers. The difference is that these tips aren't presented at random; they're organized to keep fixes for 201 problems right at hand. This "problem approach" makes the volume a good place to start, but you'll need backup home-maintenance manuals (both Reader's Digest and Time-Life Books have new ones) for the nitty-gritty. **PS**

SOURCES FOR BOOKS SHOWN

(Listed in same order as books are displayed, and reviewed in this and last month's column. Local bookstores will usually order for you books they don't stock, or any publisher will mail them direct to you for price shown, plus postage.)

Dover Publications, 180 Varick St., N.Y., N.Y. 10014; Thomas Y. Crowell Co., 10 E. 53 St., N.Y., N.Y. 10022; Reston Publishing Co., Reston, Va. 22090; Holt, Rinehart & Winston, 383 Madison Ave., N.Y., N.Y. 10017; Stephen Greene Press, Brattleboro, Vt. 05301; Harper & Row (same address as Crowell); Arco Publishing Co., 219 Park Ave. So., N.Y., N.Y. 10003; Rodale Press, Organic Park, Emmaus, Penna. 18049; Parker Publishing Co., Inc., West Nyack, N.Y. 10994.

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Sears backs both the roofing and the installation.

We'll stand behind what we do for you. That also goes for Sears Siding, Guttering, Insulating Storm Doors and Windows, everything from Sears. Come to Sears Home Exterior Remodeling Department, and ask us for a free estimate or advice.

The service described in this advertisement is readily available in the greater Atlanta area, Athens, Gainesville and Rome, Ga.; in the greater Milwaukee area including Racine, Kenosha, Burlington and West Bend, Wisc.; and in these California counties: San Diego, San Bernardino, Imperial and Riverside.

**You can
trust your
house to
Sears**

© Sears, Roebuck and Co. 1978



The Hot One.



The BernzOmatic Jet Torch, the most trusted name in torches.

It's one of the most versatile home repair tools you can buy.

The BernzOmatic Jet Torch can solder, seal, loosen bolts, heat tile, remove paint and window putty, remove ice, thaw frozen pipes—the list goes on and on. You can even use it for hobby and craft applications. And the BernzOmatic Jet Torch does it all easily and economically!

It's no wonder that for over 20 years, do-it-yourselfers have recognized the BernzOmatic Jet Torch as the first and best torch for a variety of home repairs.

Don't put off those home repairs any longer. See the BernzOmatic Jet Torch at your BernzOmatic dealer's soon.



BERNZOMATIC®
BERNZOMATIC CORPORATION, ROCHESTER, N. Y.

Modular hydroponics

[Continued from page 120]

able to pump up the nutrient. A dab of silicone caulk reduced the hole to its proper size.

The only problem of any real consequence that I experienced had nothing to do with hydroponics. My big problem has been insects, especially on my terrace. My most effective defense against them has been to frequently blast them off the plants with the garden hose, and to spray alternately with malathion and rotenone.

Tips for successful growing

You can grow just about anything hydroponically, but it isn't a magic system that lets you circumvent the normal needs of the plants. Here are some suggestions that should help to make your soilless garden a success.

- Choose plants that will do well in the light, humidity, and temperature in the area where your growing bed will be. Books will give you some guidance, but you'll also have to experiment.

- If you grow plants indoors, you may have to pollinate some of them. With tomatoes, just shake the vines vigorously whenever they are in bloom. With the cucurbits (cucumbers, squash, gourds) you'll probably have to use a small watercolor brush and transfer pollen from the male to the female flower.

- When your plants are nearing maturity, try increasing the strength of the nutrient solution by 50 percent. I even feed my mature watercress a double-strength solution and get bigger leaves and bushier plants. But beware of souping up the solution for young plants. I tried a double-strength solution on six-inch tomato plants and got yellow leaves and brown spots.

- When you plant your crops, leave about half the distance between plants that you would for soil gardening. I tried planting them even closer and found that the big ones shaded the little ones. Leave room for each plant to develop to its full size. P 5

FOR FURTHER INFORMATION:

"Hydroponics," *The Mother Earth News*, Jan./Feb. '77, pp. 80-84. Includes a list of hydroponics suppliers and a bibliography.

Beginning Hydroponics, by Richard E. Nicholls. Running Press, 38 S. 19 St., Philadelphia, Pa. 19103. (\$3.95 + 25¢ postage.) Includes good troubleshooting guide and extensive list of hydroponics suppliers.

"Hydroponics Packet," \$1.25 from the Institute for Local Self Reliance, 1717 18 St., Washington, D.C. 20009.

The Hydroponics Society of America, a non-profit membership organization. For information write to P.O. Box 516, Brentwood, Calif. 94513.

The Hot One, II.



The brand-new BernzOmatic Jet Torch II, the most versatile propane torch you can buy.

It outperforms any other propane torch! The BernzOmatic Jet Torch II burns with heat so highly concentrated, it can actually braze-weld metal. It can handle literally hundreds of do-it-yourself jobs requiring strong, weld-like repairs. And because the BernzOmatic Jet Torch II concentrates the heat, it can do them much faster, too.

Look at the home repair jobs it can do—and the time and money it can save you in replacement costs. Repair garden tools, lawn mowers, toys, fences and metal furniture. Use it for metal sculpture, auto body work, metal bending, and many other jobs.

See the BernzOmatic Jet Torch II at your dealer's soon.



BERNZOMATIC®
BERNZOMATIC CORPORATION, ROCHESTER, N. Y.

[Continued from page 85]

"But even that wasn't enough for the small probes," Dorfman reveals. Because of their smaller size those probes consistently overheated in the Hughes "pizza oven," a facility built to heat-test them. "The answer was finally to replace the nitrogen in the small probes with xenon, which has heavier molecules and is even less heat conductive," he said.

The final plunge to the surface for the large probe will be done without the parachute. It jettisons at about 26 miles, leaving only the probe to slog downward through the thickening soup. By the best estimate anyone can give, it will take the probe another 38 minutes to find land.

The three small probes go through a similar process, but without the parachute. They are timed to turn on shortly before entry, then hit the Venusian atmosphere with a deceleration force that could reach 565 g. (Hughes was able to test them only to 400 g on Earth, so there's no proof they'll survive.)

"There's no requirement that any of the probes survive impact," Dorfman is careful to point out, but there is an obvious hope that one or more probes will transmit at least briefly from the surface.

While the probes are carrying out their piece of the mission, the Pioneer Venus orbiter will be circling the planet every 24 hours in its highly elliptical 41,000-by-120-mile orbit. Designed for a minimum lifetime of 243 days (one Venusian rotation), the orbiter's scientific instruments will sample and monitor the atmosphere in a variety of ways.

Only one experiment, radar mapping, is aimed at the Venusian surface. It will record surface elevations beneath the orbiter with an accuracy of about 330 feet. Another instrument looks outward to monitor transient gamma-ray bursts from astronomical sources.

Other orbiter experiments and equipment are:

- Neutral-particle mass spectrometer to measure particle densities in the upper atmosphere.
- Charged-particle mass spectrometer to measure ion distributions and concentrations.
- Thermal-electron-temperature Langmuir probe to determine the thermal structure of the Venusian ionosphere.
- Charged-particle retarding-potential analyzer to determine pri-

mary energy-input sources to the ionosphere, and to analyze solar wind and other processes there.

- Airglow ultraviolet spectrometer to investigate the thermosphere, with data including temperature, energy balance, and more.

- Temperature-sounding infrared radiometer with a primary objective of determining vertical temperature profiles in the upper atmosphere.

- Cloud photopolarimeter/imaging to study distribution of cloud and haze particles, circulation patterns, apparent cloud motions, and more.

- Magnetic-field fluxgate magnetometer to measure the weak Venusian magnetic field and related phenomena.

- Solar-wind plasma analyzer to measure the solar wind and how it interacts with Venus.

- Electric-field instrument to look at the interaction between the solar wind and plasma, variable locations of the Venus bow shock, and other effects.

The Pioneer Venus orbiter is virtually identical in size to the multiprobe bus, but (at 704 pounds) weighs less. It is controllable from Ames and its periapsis (low point in orbit) will be adjusted briefly at least eight times during the mission to about 90 miles, allowing instruments to perform virtually on site as the orbiter passes it.

Atmospheric drag

In addition, a variety of measurements using radio occultation will provide data on high-altitude temperatures, pressures, and densities. Additional information will come from analyzing atmospheric drag on Pioneer in orbit.

As this is written, only one major problem remained outstanding and it was getting Dorfman's constant attention. Those vital battery packs in the probes—the batteries that must work or all is lost—were mysteriously discharging. With an early June date to ship the multiprobe spacecraft to the Florida launch pad, Dorfman was optimistic that the trouble would be found and fixed in time.

But still he maintains a note of caution. "It has been very difficult to test this spacecraft in the environment it will face on Venus," Dorfman sighs. "We just can't duplicate Venus on Earth."



The Hottest One.

The unique BernzOmatic Oxygen Cutting/Welding Torch, the first professional-style welding rig for do-it-yourselfers.

It's the ultimate torch! Like a professional rig, the new BernzOmatic Oxygen Cutting/Welding Torch can cut, weld, braze and solder, yet is much handier and easier to use. It's totally portable and fits easily into tight spots not easily accessible with a professional rig. It's even styled like a professional rig and uses real oxygen and either propane or Mapp gas (Reg. trademark Airco, Inc.) supplied in separate cylinders.

What's more, you can use it for all types of indoor and outdoor household repairs, from plumbing to jewelry-making, and for auto body work and van conversion.

See the amazing BernzOmatic Oxygen Cutting/Welding Torch at your dealer's soon.



BERNZOMATIC®
BERNZOMATIC CORPORATION, ROCHESTER, N. Y.



VISIT YOUR HANDY HARDWARE HOME CENTER NOW AND SAVE





Plio-Nail vs. The Nail

Goodyear Plio-Nail™ construction adhesive is designed for tough sub-flooring and joist work. Plio-Nail® panel adhesive is for drywall and paneling installations.

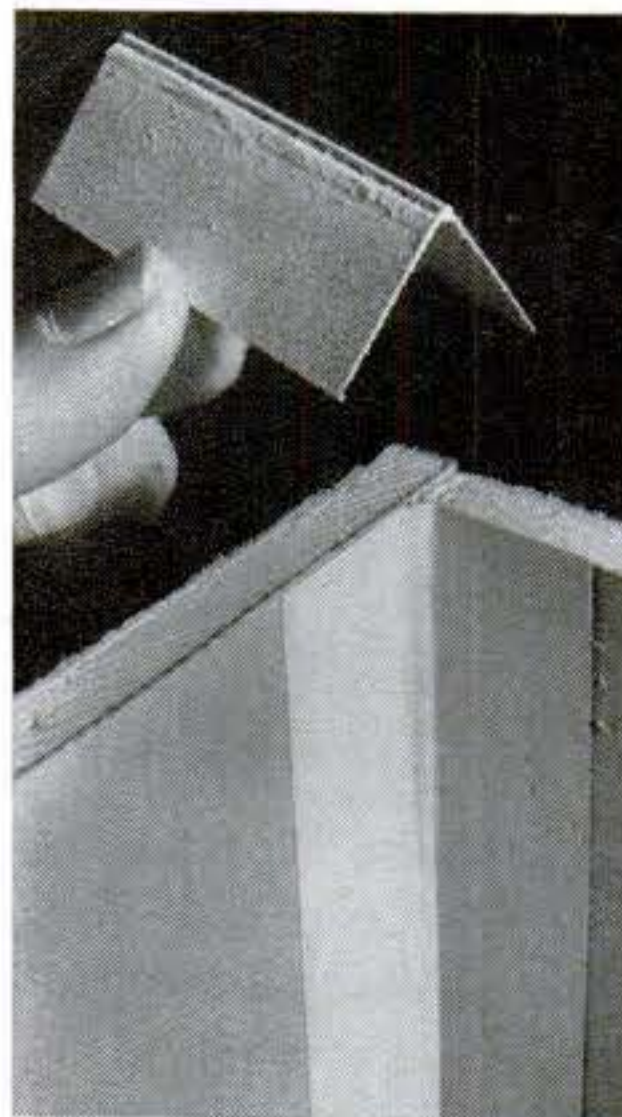
Plio-Nail bonds tight to eliminate some of the headaches caused by nails. With Plio-Nail there's no worry about nails popping, squeaking joints or finishing work on drywall. Plio-Nail is fast, easy and strong for both paneling and construction. Both types meet tough building code and HUD requirements.

Look for the Goodyear blimp display hanging in your store. That's where you'll find Plio-Nail adhesives. Tough as nails.

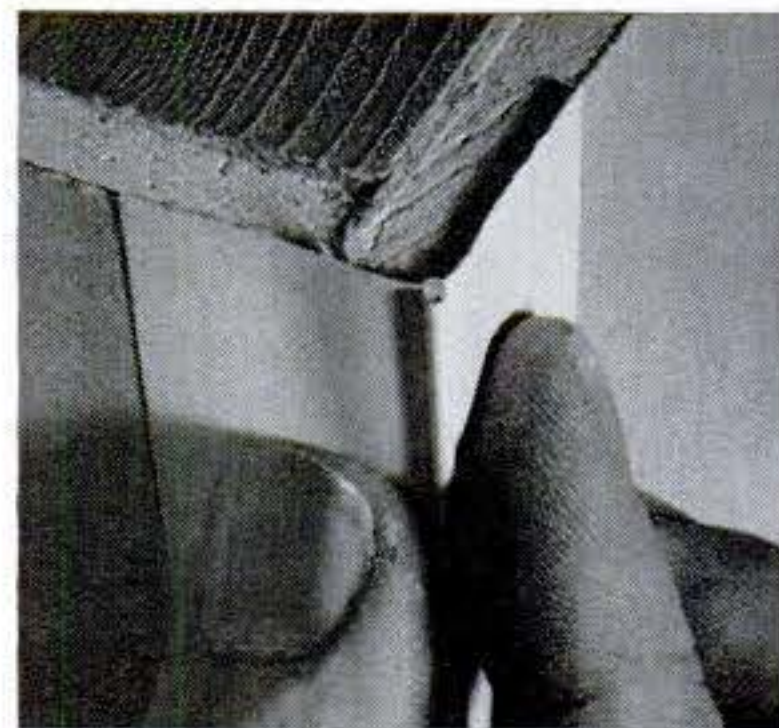
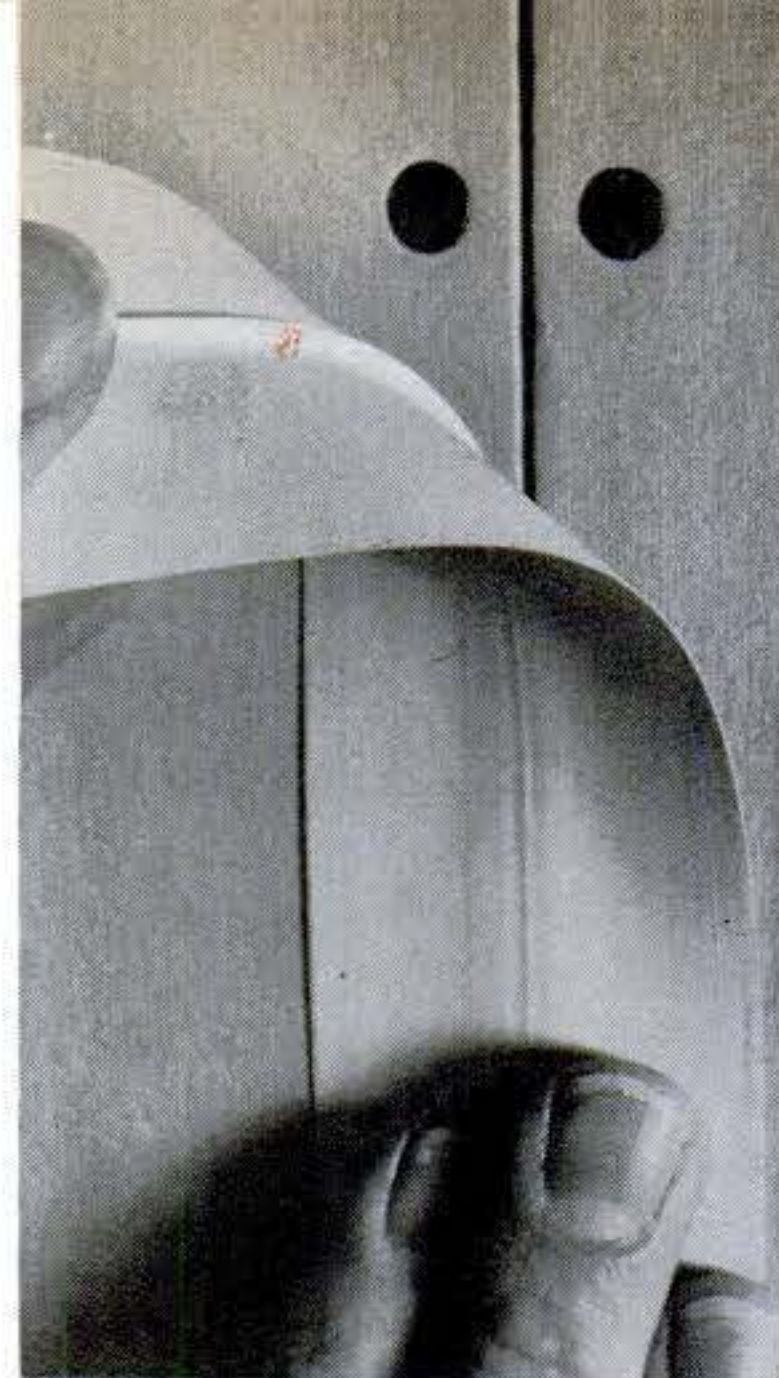


GOODYEAR
CHEMICALS

Goof-proof drywall tape



Tape's spline fits between panels to assure alignment. Outside corner tape has tough vinyl bead that won't dent like metal. Inside corner tape (above) makes for a smooth job.



If you've ever worked with drywall, you know the easy part is putting the stuff up. Then comes the long and tedious job of taping and filling the joints. This job is such an art that many carpenters won't touch it. They subcontract that work to a specialist called a taper. Now there's a new self-adhesive vinyl drywall tape on the market, called EZT, that may cost those tapers some work. Here are its advantages:

- Its pressure-sensitive backing sticks it firmly in place without an embedment coat of compound.
- A special spline slips between panels, making the tape self-aligning.
- Air bubbles—a common problem with conventional paper tapes—are virtually eliminated.
- There's no waiting once the tape is up. You can cover it with a wide finish coat of compound immediately. With care, that coat may be the only one required. Using paper tape, two or three coats are required.
- There's little need for sanding, for the joints finish smoothly.

EZT tapes come in three types: one for joints, one for inside corners, one for outside corners.

Using these tapes, you install the drywall in the conventional manner, but with two exceptions: First, you leave a slight gap between panels to allow space for the alignment spline. Do this by tacking three drywall nails into the stud beside the first panel you install. You butt the next panel against these nails, and remove them when the panel is installed.

Second, you do not dimple the nailheads along the edges of any panels. Any nail to be covered by EZT should be *flush*. Dimpling creates air pockets.

EZT tapes are made by the Plastics Division of Minter Homes Corp., Box 1060, Huntington, W. Va. 25173. Price: about \$4.95 for a pack of four strips, each four feet long.—A. J. Hand

INSULSPRAY[®] FOAM PUTS THE INSULATION POWER OF 11-FOOT-THICK BRICKS* IN A 3-1/2 INCH SPACE BETWEEN YOUR HOUSE WALLS.

WHY INSULATE YOUR WALLS?

House walls are a major source of heat loss and gain in a typical home. Of all the products for insulating your house walls, there's not one with a higher Resistance Value (R-Value) than Insulspray foam insulation from Borden.

INSULSPRAY FOAM IS EASILY INSTALLED.

It flows up and down inside the cavity between the house walls to form a rigid "insulation sandwich." In winter, Insulspray foam holds your expensive heat inside. In summer, it keeps heat outside. The house is quieter and more comfortable year-round.

HOMEOWNERS EXPERIENCE SAVINGS AND COMFORT!

In a 1977 survey of 1,296 homeowners who had Insulspray foam installed, 95% reported their homes are more comfortable, and 75% said their homes are quieter. 74% have recommended Insulspray foam to friends or neighbors. What about savings? Read these actual comments!

"I think it is a real fuel saving product. Money well spent."

W.H., Illinois

"It saves us money. Our house is not drafty or noisy."

Mr. & Mrs. L.L., Ohio

"My home is warmer and quieter since insulation — heat bill took a definite drop."

B.K., Washington

"If you want to do something good for your home and your wallet, install Insulspray insulation. It is a great value."

C.C., Connecticut

QUALITY IS BORDEN'S POLICY.

Insulspray foam provides you the assurance of dealing with one of America's oldest and most trusted names. It is Borden's policy to please you these important ways:

BORDEN'S 'NO SHORTAGE'

ASSURANCE. Don't wait to insulate. There's a plentiful supply of Insulspray foam.

BORDEN'S QUALITY STANDARDS.

Insulspray foam is produced under exacting specifications with numerous quality checks.

BORDEN-CERTIFIED CONTRACTORS.

To qualify for certification, contractors must complete a thorough training program. Ask to see your contractor's credential card from Borden.

BORDEN'S HOMEOWNERS

CERTIFICATE offers you a permanent record of this value-enhancing improvement to your home.

BORDEN'S PATENTED DIFFERENCE.

Not all insulation foams are alike. Insulspray foam is patented and has been used to insulate homes throughout the U. S. and Canada for years.

For insulation protection equal to a giant brick, and the consumer protection of the trusted Borden name, have your walls insulated now with Insulspray foam.



insulspray[®]

Borden Chemical/Borden, Inc.
180 East Broad Street,
Columbus, Ohio 43215



Insulspray foam
is produced by
Borden Chemical,

Division of Borden, Inc. Insulspray is a
registered trademark of Borden, Inc.

* The R-Value of Insulspray foam is 39 times greater than that of brick. Brick is a good building material but a poor insulator. R-Value of brick is 0.11, while the R-Value of Insulspray is 4.3 per inch.

Orbital pad sanders — easy way to a smooth finish



Smoothing wood and putting a mirrorlike shine on lacquer and varnish are the main

jobs of pad sanders. They are sometimes referred to as "finishing sanders."

Whether you're finishing a new wood project or refinishing an old one, a pad sander is essential for sanding the wood to its proper smoothness. Sure, you can do it by hand. But that's much more difficult and time-consuming. Besides, the wide, flat pad easily produces a level finish that's hard to duplicate by hand.

What kind of pad sander should you buy? There are two kinds: low-speed and high-speed. Both sand with a tiny orbital motion. The low-speed jobs usually produce between 3000-4000 orbits a minute; the high-speed models run between 8500-12,000 orbits.

Most woodworkers who have used both types prefer the high-speed sander because it is easier to control and allows better access into tight corners. This is due primarily to its smaller orbit diameter.

Many craftsmen feel that the high-speed units sand faster and produce a superior finish as well. In our tests, we were unable to detect any significant differences between the quality of the finish obtainable with the two types.

Some low-speed pad sanders have a dual-action feature, controlled by a lever, that allows two sanding motions—a straight-line, back-and-forth action as well as the usual orbital motion. When using a dual-action model for finish sanding, however, the orbital motion is recommended.

Although a pad sander is very easy to use, read the instructions that come with your model so that you'll be aware of any special features it may have.

If your sander has no oil holes (many do not), don't try to oil it. If it does have an oil hole or two, don't over-oil. An occasional drop or two is

sufficient. Excessive oil can get on the motor's windings and commutator and cause the sander to malfunction.

Although it's not essential, if you have access to compressed air, it doesn't hurt occasionally to stick the air hose against the motor's air vents to blow dust out of the motor.

Whenever the sander is not in use, make sure it's unplugged. That includes times when you're removing or replacing paper, oiling, repairing, cleaning, or just examining the unit.

Most sanders have knobs or handles that let you hold the sander with both hands. Don't use those grips to apply more downward pressure with the intention of getting the job done faster. Bearing down can cause scratches and unwanted swirl marks in the wood. Just guide the sander back and forth across the surface of the work, allowing only the weight of the sander to supply pressure.

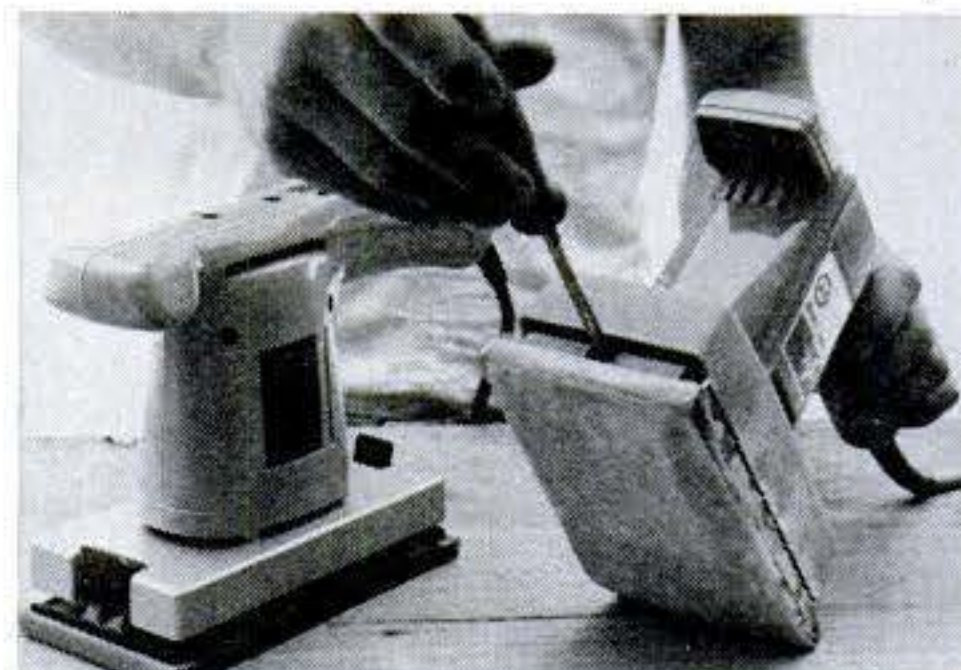
Don't go from rough to finish sanding in one jump—for example, from a coarse 80-grade paper to a fine 220. Progress by one grade of paper at a time until you achieve the desired smoothness, as you would do in hand sanding.

Because of the orbital action, I've found that it doesn't matter much whether you sand with the grain or across it—as long as you make slow strokes. Some craftsmen, though, feel that best results are obtained when you sand with the grain, as you always would, of course, if you were sanding by hand.

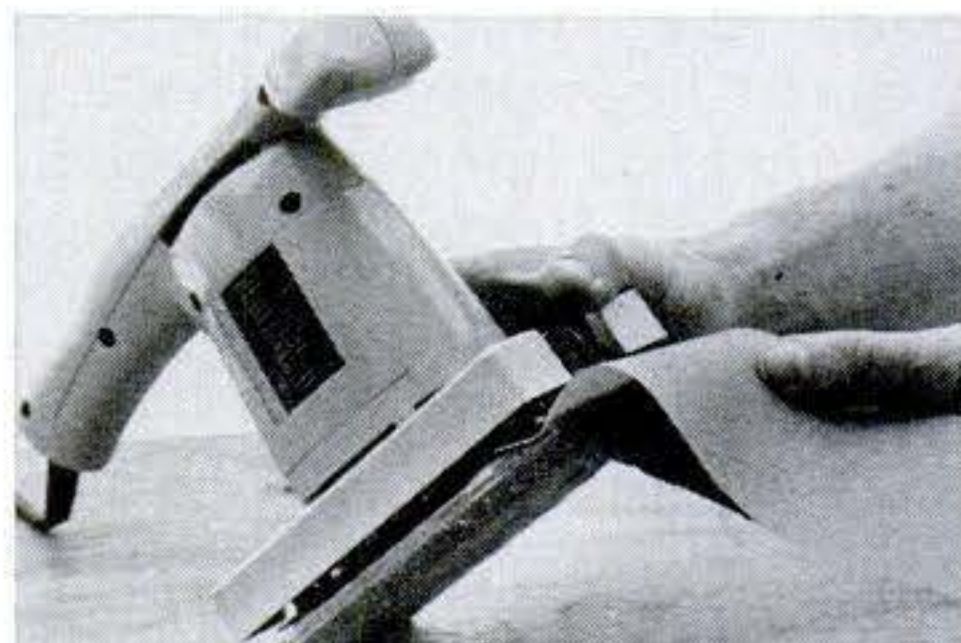
Pad sanders are widely available—Sears, Penney's, and Wards have them in their catalogs and stores. And most hardware stores either stock them or can order one for you. (See our buyers'-guide table for shopping information.)—Ray Hill



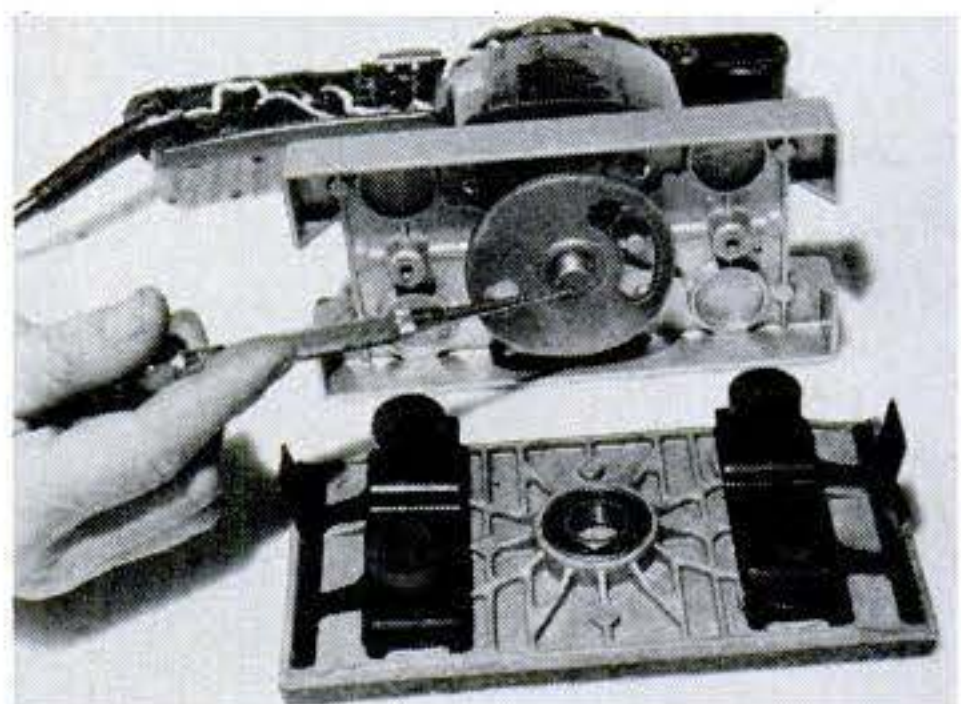
High-speed orbital sander by Rockwell (right) looks like but is much lighter than Craftsman low-speed dual-action sander.



To replace sandpaper, you may need a screwdriver to separate clamp from pad, as demonstrated with this Black and Decker.



Tab-type clamp, a little more convenient, is found on J.C. Penney unit. Just press clamp with thumb to release paper.

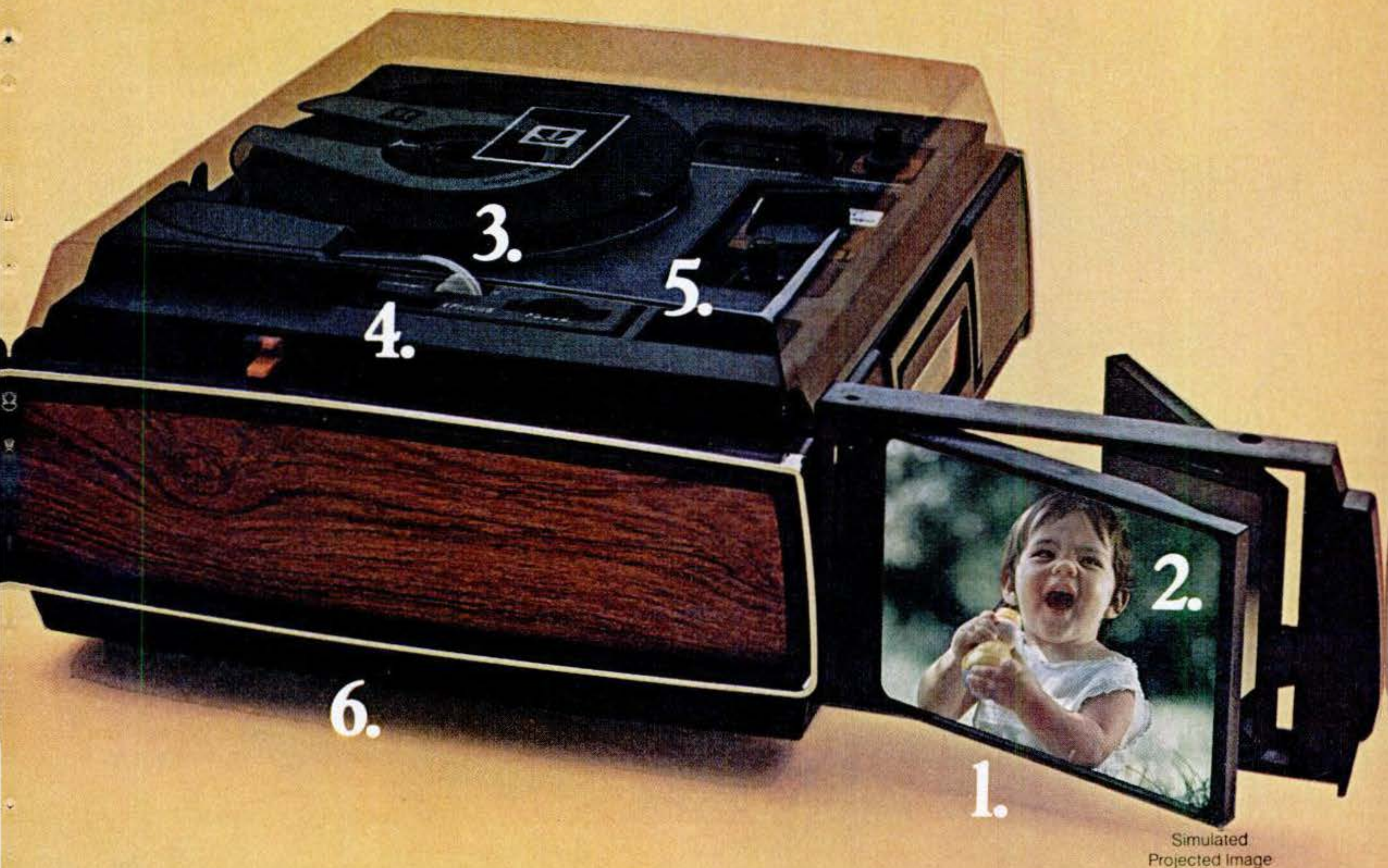


Orbital action is accomplished by off-center crank that (on high-speed units) fits to armature shaft.

	Model No.	Orbits per minute	Diameter of orbit (in.)	Weight (lbs.)	Approximate cost (\$)	Motor horsepower
Black & Decker	7404	10,000	5/8	3	15	.15
	7480	4000	3/16	5 1/2	35	.33
	7490*	4000	3/32	6 5/16	40	.33
J.C. Penney	2300	10,000	1/16	4 3/16	30	.15
	2305*	4000	3/16	5 1/4	35	.25
Rockwell	4401	10,000	1/10	3 1/4	19	.10
	4420	12,000	1/10	3 1/4	28	.10
	4480	12,000	5/64	4	65	.10
	4485	10,000	1/10	6 3/4	95	.25
Sears	1163*	4000	3/16	5 1/4	29.50	.20
	1165*	4000	3/16	9 1/4	49.50	.25
	1166*	4000	3/16	9 9/16	59.50	.50
Skil	439	8400	1/16	2 1/2	20	.07
	459	10,000	1/16	4 3/16	30	.15
	490*	4000	3/16	5 1/2	40	.20
Wards	661	10,000	1/8	4 1/4	50	.15
	8145*	3000	3/16	4 1/4	34.50	.25
	8146	10,000	1/16	4	17	.15
	8147	10,000	1/8	4	24.50	.15

*Dual action (orbital or straight-line)

Silent and Sound reasons to buy a Kodak Moviedeck projector.



Whether you have sound or silent movies, Kodak projectors have everything you need to make showing your movies easy. *Like:*

1. Watching your movies without setting up a screen or turning down room lights. Our unique pull-out viewing screen is ideal for small audiences. You also have the option of projecting your movies onto a traditional screen.
2. Bright, sharp images.
3. Automatic threading and automatic rewind that make Kodak projectors really easy to use.
4. Showing super 8 and 8 mm movies at the flip of a single switch on all Kodak projectors.

5. Replaying previous scenes in just seconds, and a choice of fast or slow motion on some models.
6. Low-profile design and smoke-tinted dust covers that make these projectors easy to look at.

Ask your photo dealer for a demonstration of Kodak silent or sound movie projectors. They're easy to use and easy to look at, and that's some image!

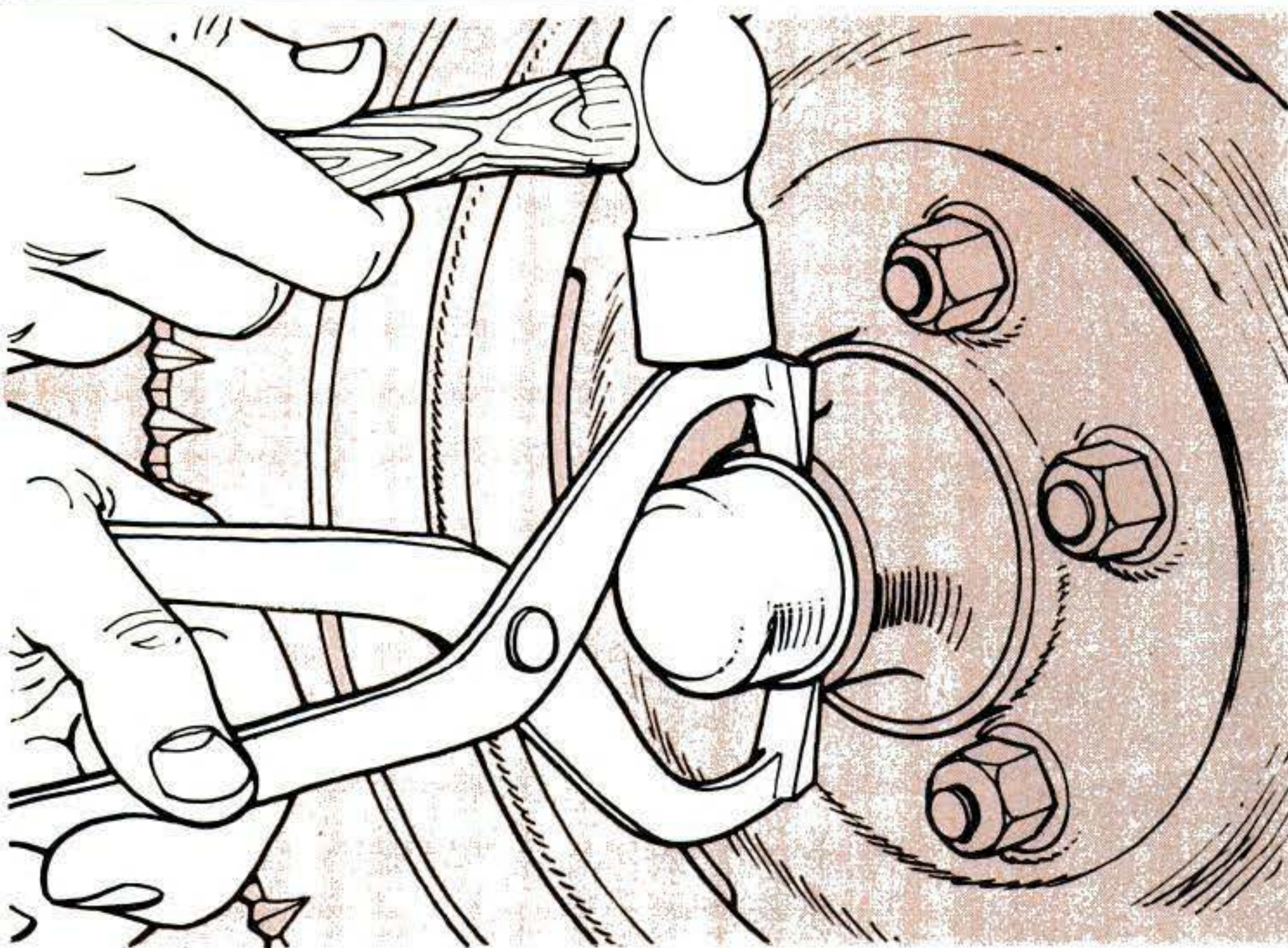
Kodak
Moviedeck® projectors



TAKING CARE OF YOUR CAR

By RAY HILL

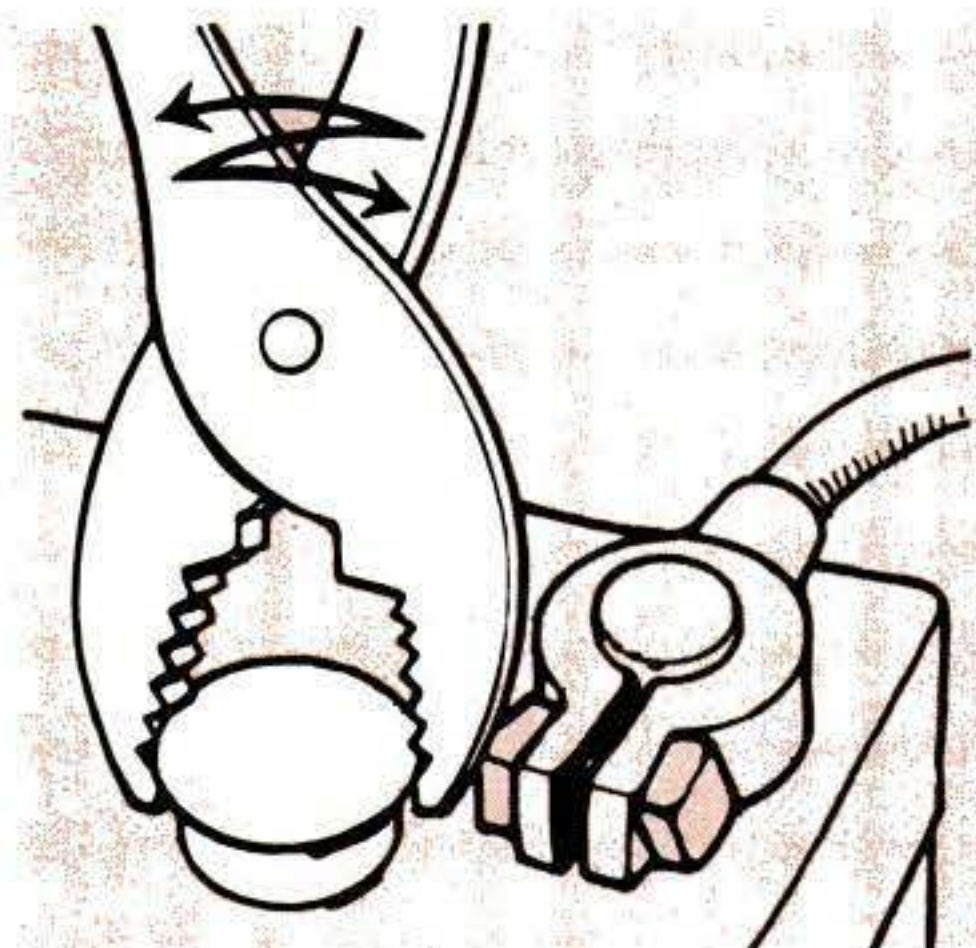
Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you \$25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.



Getting a good bite with grease-cap pliers

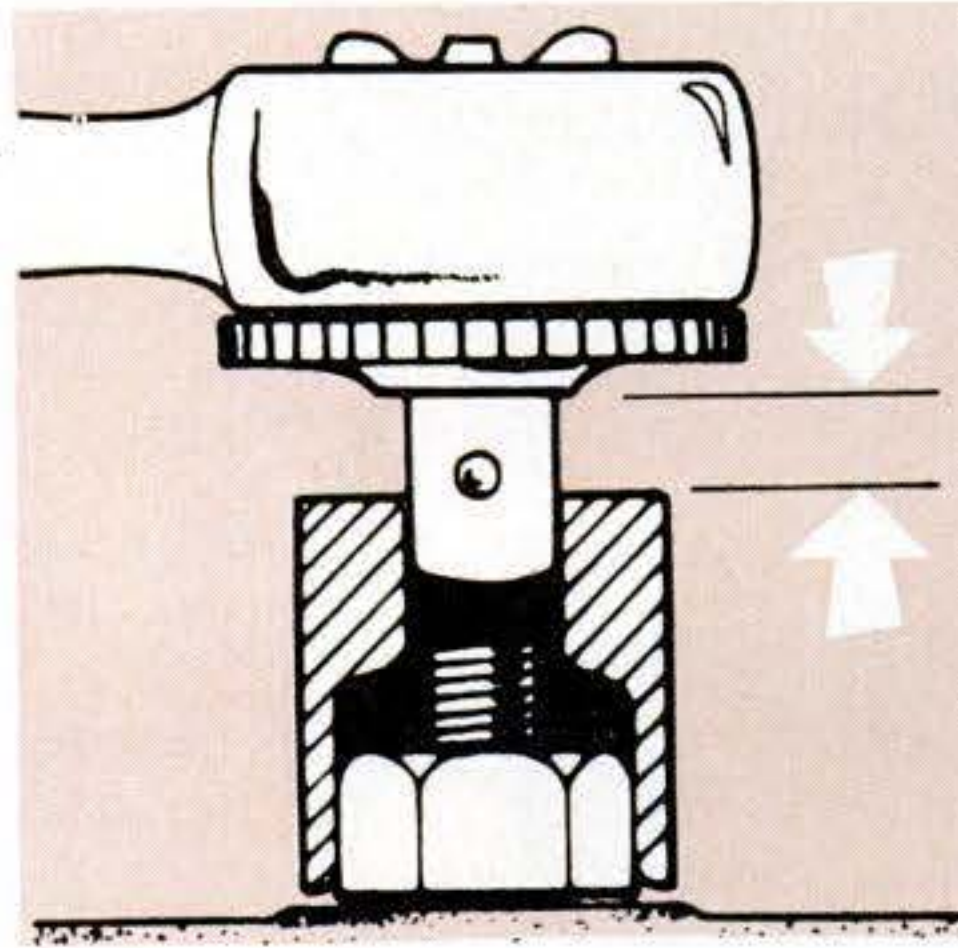
Grease-cap pliers make an easy job of removing a front-wheel grease cap—once the pliers get a bite behind the cap lip. But sometimes it's hard to get the plier jaws behind the lip—especially with short-handled pliers—because the cap fits so tightly against the wheel

hub. To solve this problem, position the pliers as shown and squeeze the handles. Now take a ball-peen hammer and tap each jaw a few times. The tapping and squeezing will force the jaws behind the lip for that proper bite. Removing the cap is now a quick, easy job.



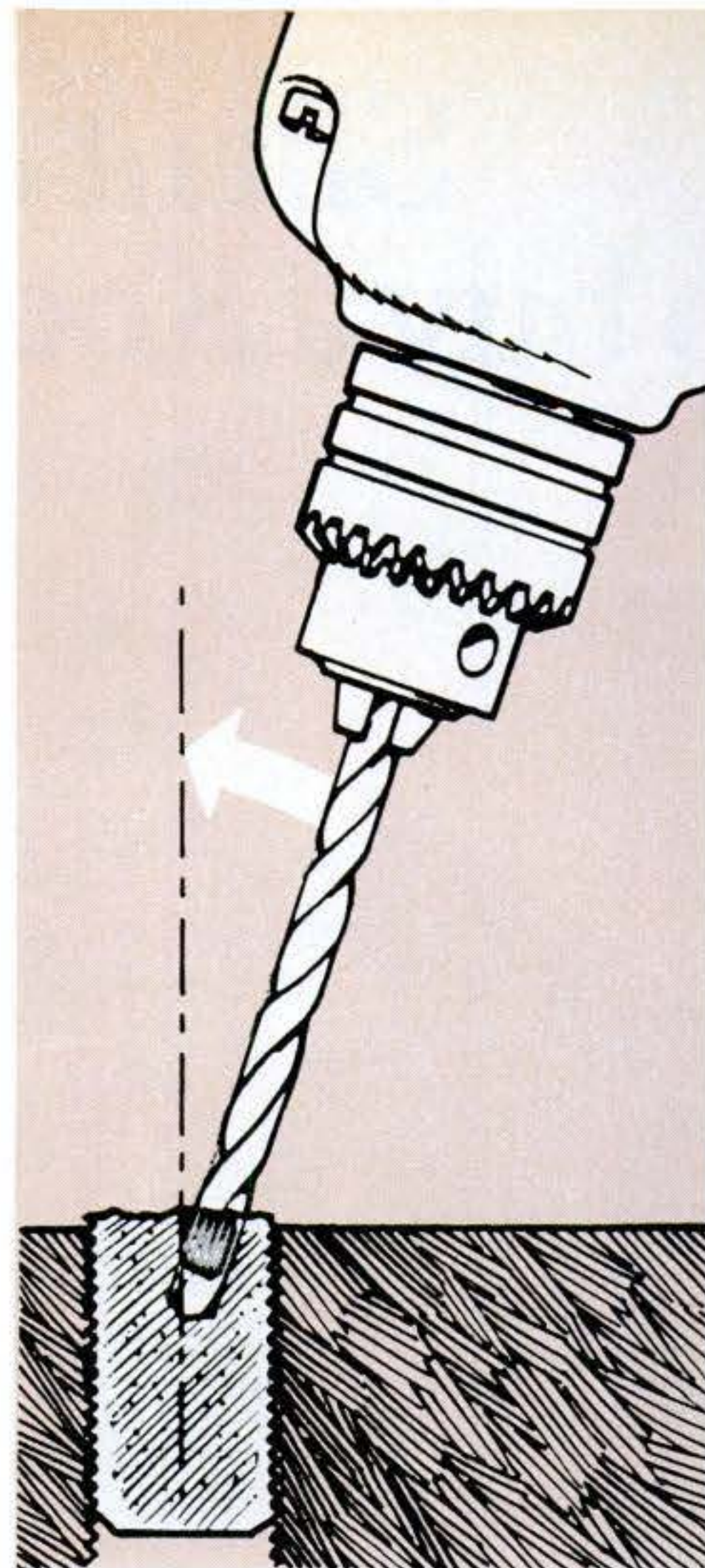
Removing stuck cell caps

On batteries (such as Delco's Y87) with flange-type pull-out cell caps that may fit too tightly to be removed by your fingers, you can use a pair of slip-joint pliers to remove them. Grip the cap as shown, and wiggle it back and forth with the pliers, while at the same time applying an upward pull on the pliers. Grip the cap with the pliers reasonably gently, though, to prevent breaking it. Replace the cap using only your fingers.



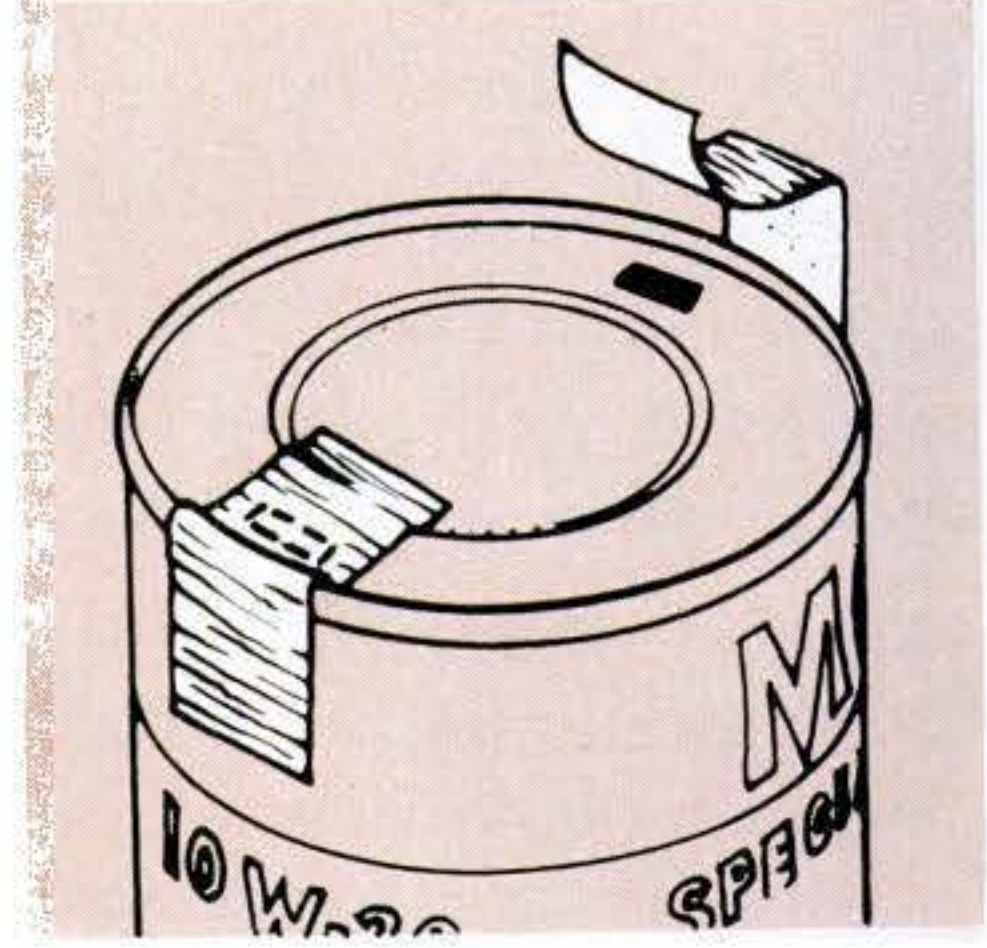
Deep-well socket unavailable?

When tightening a nut with a standard socket that's not deep enough to let you completely tighten the nut, you may be able to finish the job this way: Remove the socket from the ratchet, then slide it back on the ratchet drive-square, just enough (say $\frac{1}{8}$ "') so that the drive-square will turn the socket (as shown in the drawing above). This may give the socket the depth you need to finish tightening the nut.



Centering a hole

Drilling a hole off-center in a broken stud? To get it centered, drill a short hole at an angle as shown. Then return to your vertical drilling position. The angled hole will act as a center-punch mark, holding the drill bit in place as it drills down into the broken fastener.



Covering oil-can holes

An effective way to keep dust and dirt out of a partially used can of motor oil or transmission fluid is to use tape. Masking tape, duct tape, or plain old adhesive tape from the medicine cabinet all work about equally well. Don't cut the tape so that it's just big enough to cover the hole. For best adhesion, make it long enough so that it extends a couple of inches or so down the side of the can and along the top.

OMNI'S ARMY.

The new Dodge Omni. People just seem to like it. Because Omni tries so hard to please. With a 99.2-inch wheelbase. A 1.7 litre overhead cam engine. And a likeable base sticker price of only \$3706*, including standard features like an AM radio, vinyl body side moldings, and white sidewall tires.

The Omni shown below with a number of stylish additions has a sticker price of just \$3981*.

\$3981* (PRICE OF CAR AS SHOWN)
\$3706* (BASE STICKER PRICE)



**MOTOR TREND
CAR OF THE YEAR**

Even big people like Omni. For example, the four weekend hackers you see here. All four of their golf bags fit in a covered compartment behind the rear seat. If this were a twosome, that rear seat could be



folded down giving 35.8 cubic feet of space. Enough to handle their bags

and a couple of carts. Omni's built here in America with American-sized people very much in mind.

Lots of room. That's one advantage of Omni's front-wheel drive. The size of the tunnel you find in the middle of most conventional rear-wheel-drive cars is reduced. So there's more room for legs and stuff.

Then there's ride. It's stable. Comfortable. Because the right kind of

attention was paid to things like spring rates and jounce travel. Front-wheel drive with rack-and-pinion steering does its part, too.

Another thing, with four good-sized suburbanites like you see here, Omni's gritty four-cylinder engine can make this car move with plenty of authority. No sweat

at expressway speeds.

Remarkable, when you consider the EPA estimated mileage ratings achieved by that engine and Omni's standard four-speed manual transmission and a 3.3 transaxle ratio:

**EPA ESTIMATES:
30 MPG HIGHWAY/25 MPG CITY.**

Now, your mileage may vary according to your car's condition, equipment,

and your driving habits. And California mileage is lower. But these are noteworthy ratings for a car that can do all the Omni can do.

Here's a suggestion. Visit your Dodge Dealer. Have him wheel out an

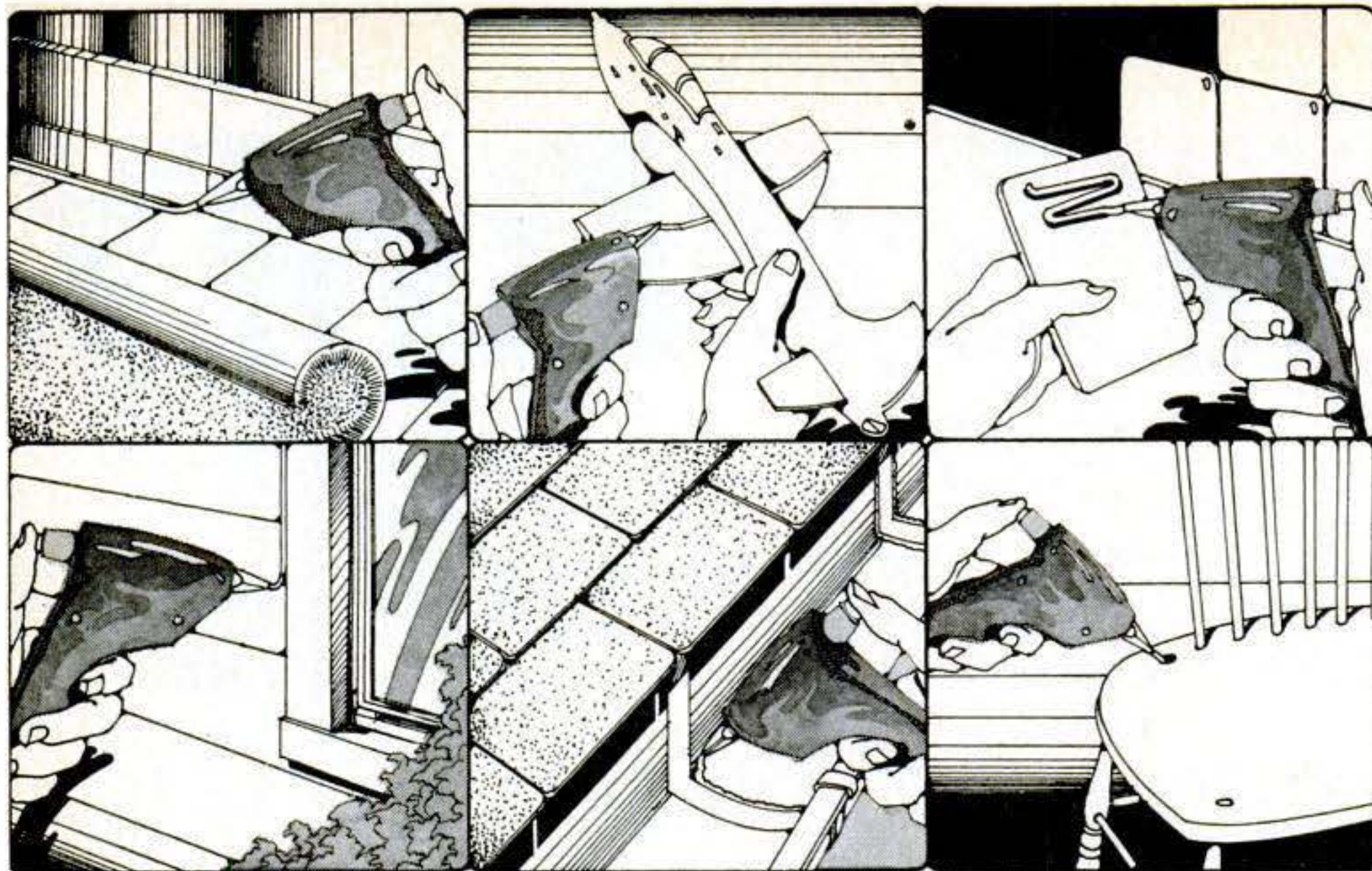
Omni. Take it out on the freeway. Over a bumpy road. We have

a feeling when you're through, you'll be ready to buy, or lease. Omni's like that. It attracts fans.

**DODGE
OMNI.
IT DOES IT ALL.**

*Excluding taxes and destination charges.

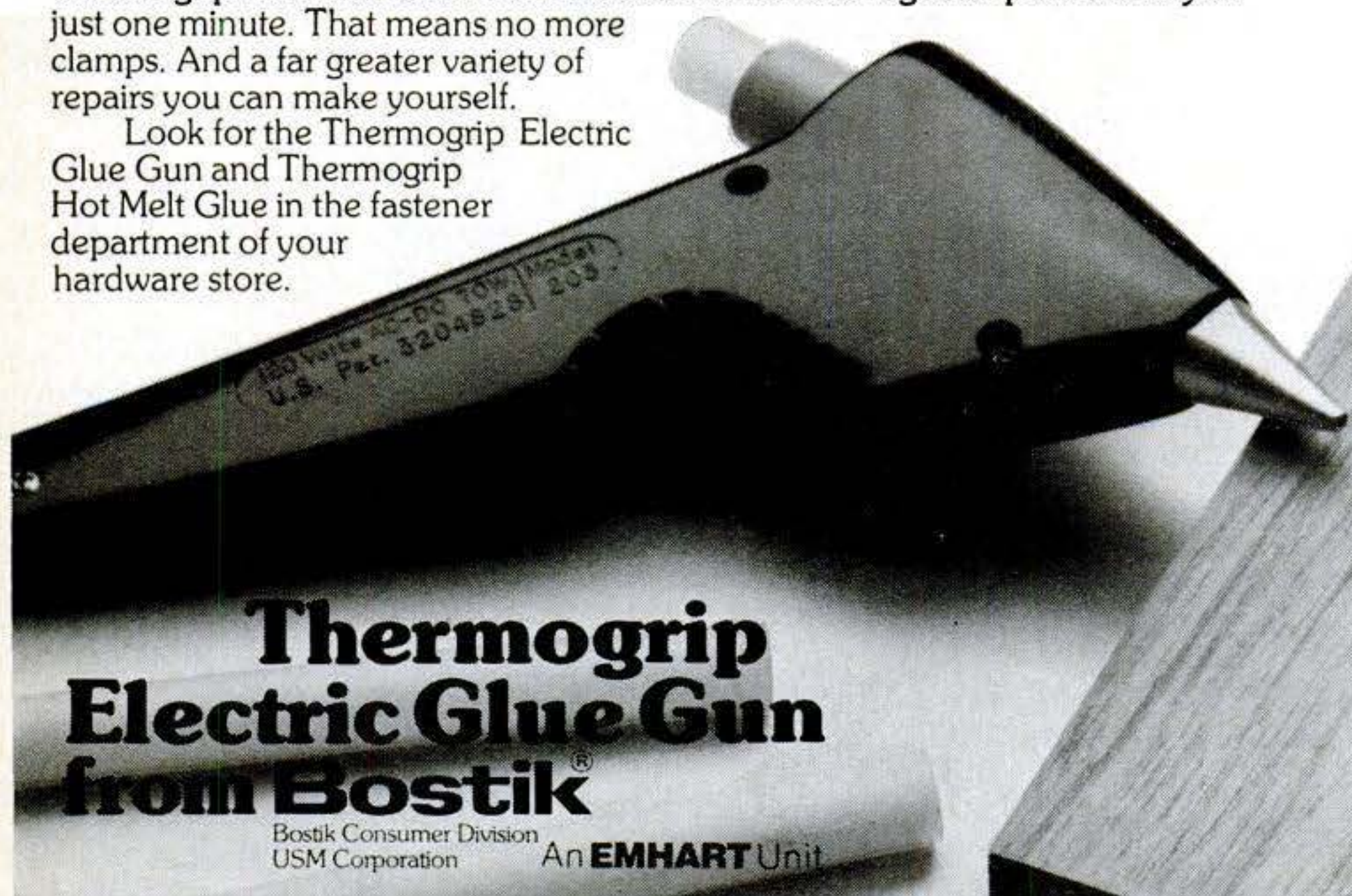
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Neat as a pin. And lightning fast.

The Thermogrip® Electric Glue Gun from Bostik applies glue in a controlled flow with no mixing, no mess. Makes all your gluing jobs even easier. And Thermogrip Hot Melt Glue is so fast it bonds surfaces together permanently in just one minute. That means no more clamps. And a far greater variety of repairs you can make yourself.

Look for the Thermogrip Electric Glue Gun and Thermogrip Hot Melt Glue in the fastener department of your hardware store.



**Thermogrip
Electric Glue Gun
from Bostik®**

Bostik Consumer Division
USM Corporation An **EMHART** Unit

ATLAS
6" SCREW-CUTTING
LATHE WAS \$495
NOW ONLY \$295
(plus \$30 handling and shipping)



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Super-slippery oils

[Continued from page 50]

very conservative in this area: "It's very difficult to translate the results we've seen into direct claims of improved engine life. Other things being equal, if a person uses this oil instead of a conventional oil, he's going to have improved engine life because there is reduced wear. But we need more experience before we can claim longer engine life."

Do these friction-modifier oils offer extended drain periods? Right now neither Arco nor Exxon is recommending drain periods beyond those specified by car makers, although some tests indicate such extensions are feasible.

As good as synthetics?

Some synthetic oils such as Mobil 1 use the low-viscosity approach to fuel savings. Their different oil-film characteristics let you use a lighter oil and thus reduce the pumping losses and internal viscous drag. Also, since synthetics are less volatile and therefore lose less to evaporation, oil consumption can be held to levels as good as or better than thicker petroleum oils in a tight engine. Of course, if an engine has worn seals, poor gaskets, and other failings common to age, you can expect more leakage with a low-viscosity synthetic than with a 10W-40 friction-modifier oil or a 10W-40 synthetic.

Arco considered the low-viscosity approach when the company first began developing a high-mpg oil. "We did, in fact, see a benefit through viscosity reduction," says Keller. "The 5W oils do give better fuel economy than straight 40 weights. We also found improvements with friction reducers like graphite and others. We ended up with a 10W-40 because we felt that the kinds of problems one gets with low-viscosity oils would be in the area of wear. Another problem would be oil consumption. So we decided to go with a 10W-40."

Obviously, both synthetics and the new low-friction petroleum oils have their own merits. And given the cost spread between them (about \$1.50 vs. \$5.00) there seems to be room for, and rumors of, blending of synthetics and petroleum to gain some of the best of both worlds. Pennzoil, of course, is already marketing P-Z-L, a blend of petroleum and synthetic lubricants. But to date, the company is claiming only that you can run your car farther between oil changes, not that you'll get better gas mileage. **P5**

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The bucket seats are more comfortable, more colorful. And now you can order them in fun-to-touch fabrics. Mounted on curved tracks, the new seats allow a higher position for the shorter driver and more headroom for the taller driver. And you can order bench seating for up to 15 people.

2. MORE ROOM, MORE QUIET.

We've made the engine cover smaller to make the people compartment bigger and increase the footroom. And on Custom and Royal models we've put in more sound insulation and made suspension improvements to make the ride quieter.



3. EXCLUSIVE TRAVEL SEATING PACKAGE. This new factory-installed option on B200 and B300 Royal Sportsman lets you easily convert from two three-passenger bench seats to a dinette set to a double bed. The wood-grained-finish tabletop stows out of the way when not in use. The package makes your Sportsman into a home away from home.

4. 23MPG HWY / 17MPG CITY.

EPA estimates for Dodge Sportsman B100 wagon, with standard 225-cubic-inch six-cylinder engine and manual transmission. Pretty good for a wagon that does this much work. Your mileage may vary according to vehicle condition, equipment, and how it is driven. California mileage is lower.

5. NEW OPTIONS.

Sky Lite sun roofs, air conditioning, and more. Trailer-towing packages for up to 7000 pounds gross trailer weight. Six different kinds of radios including units with 40-channel CB.

6. MORE ROOMINESS.

Maxiwagon has eight inches more loadspace length this year.

Room for more cargo and more fun. And its rear quarter windows wrap right around the corners to make backing up a snap.



Put our new features together with Dodge dependability and value, and you'll see why we keep on selling more wagons than anyone. Buy or lease one or a fleet . . . at your Dodge Dealer's.



NO.1 IN VANS AND WAGONS.*

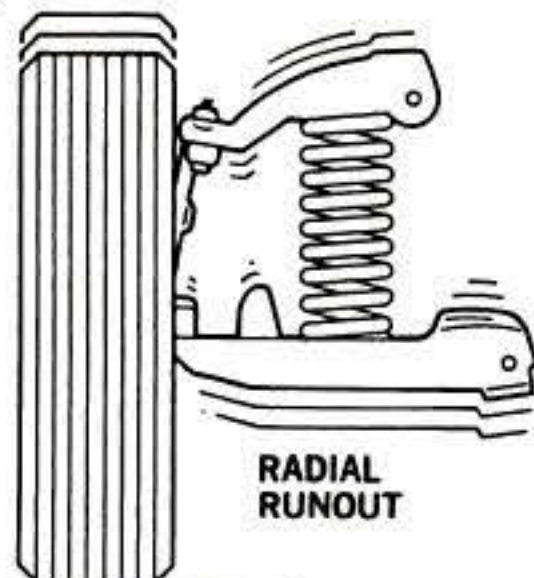
* Passenger van-type vehicles known in the industry as wagons.



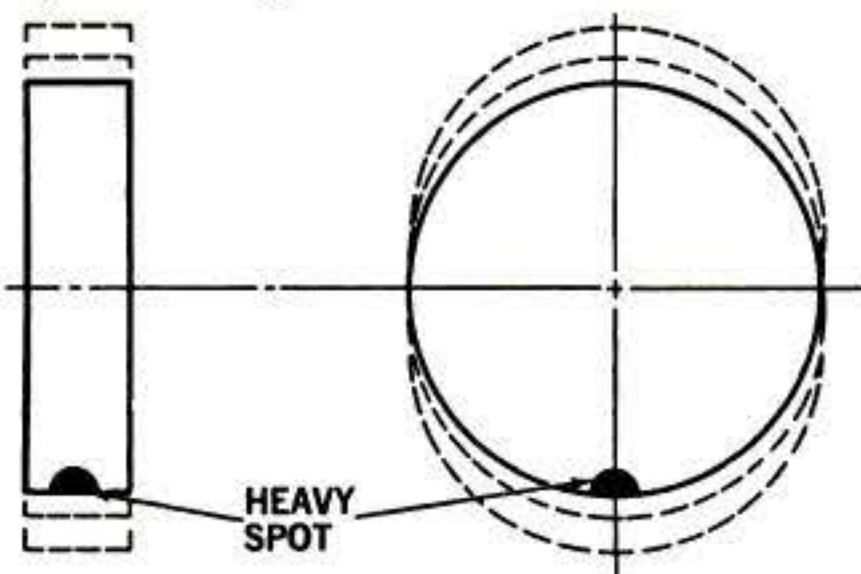
Car-care quiz answers

1 Mechanic A's statement is correct. When a head gasket blows out between two adjacent cylinders, the pressure from one cylinder leaks into the other cylinder while the compression test is being made. Usually, during the test, the mechanic can also hear leakage coming out of the spark-plug hole of the adjacent cylinder.

Mechanic B's statement is wrong. Since the timing for valve operation is primarily controlled by the camshaft drive mechanism, the valves for all cylinders would be equally affected by a change in timing. This would tend to cause the compression pressure to vary in every cylinder and not just in the two adjacent ones.



2 Mechanic A's diagnosis is correct. Radial runout is a condition where the wheel-and-tire assembly is out of round. As the tire rotates, the spindle will have to move up and down in relation to the road surface as shown. This movement transmits a vibration through the suspension parts to the car frame.



Mechanic B's diagnosis is also correct. Static imbalance is a condition where there is an unequal distribution of weight around the axis of the tire. As the tire rotates, centrifugal force will act on the heavy spot causing the tire to tramp or hop. This tramping action causes a vibration which is transmitted through the suspension parts to the car frame.

3 The electrolyte in an automobile battery is a solution of approximately 35 percent sulfuric acid and 65 percent water. Sulfuric acid has a specific gravity of 1.835 while water is 1.000. This gives a normal electrolyte solution a specific gravity of approximately 1.270.

As a battery discharges, the sulfuric acid in the electrolyte reacts with the lead plates to form lead sulfate. This reduces the amount of acid in solution, which in turn lowers the strength and the specific gravity of the electrolyte. Since the strength of the electrolyte is related to the battery's ability to supply power, it makes the specific-gravity reading a good indicator of the state of charge of the battery.

Refer to the table below for battery state-of-charge relationship to approximate electrolyte specific-gravity readings.

Fully charged	1.260-1.270
$\frac{3}{4}$ charged	1.225-1.235
$\frac{1}{2}$ charged	1.190-1.200
$\frac{1}{4}$ charged	1.155-1.165
Discharged	1.120-1.130

The correct answer is (B).

4 The diagram shows the basic primary circuit of a points-type ignition system. When the ignition switch is on and the points are closed, current flows from the battery to the switch, then to the coil and through its primary windings. From the coil, it travels through the distributor wire to the contact points and returns through ground back to the battery. Whenever the points open, the circuit is broken, causing the induction of a high secondary voltage within the coil, which causes spark plugs to fire.

In the circuit shown, a test light is connected in parallel with the distributor wire and points. Whenever the points are closed, current flows through the distributor wire and points to ground because they offer very little resistance in comparison to the test light-bulb filament. When the points open, the test light provides the only path to ground (which the current takes), causing the light to go on.

Mechanic A's statement is correct. If the points fail to open, the circuit is not broken and the light will not come on.

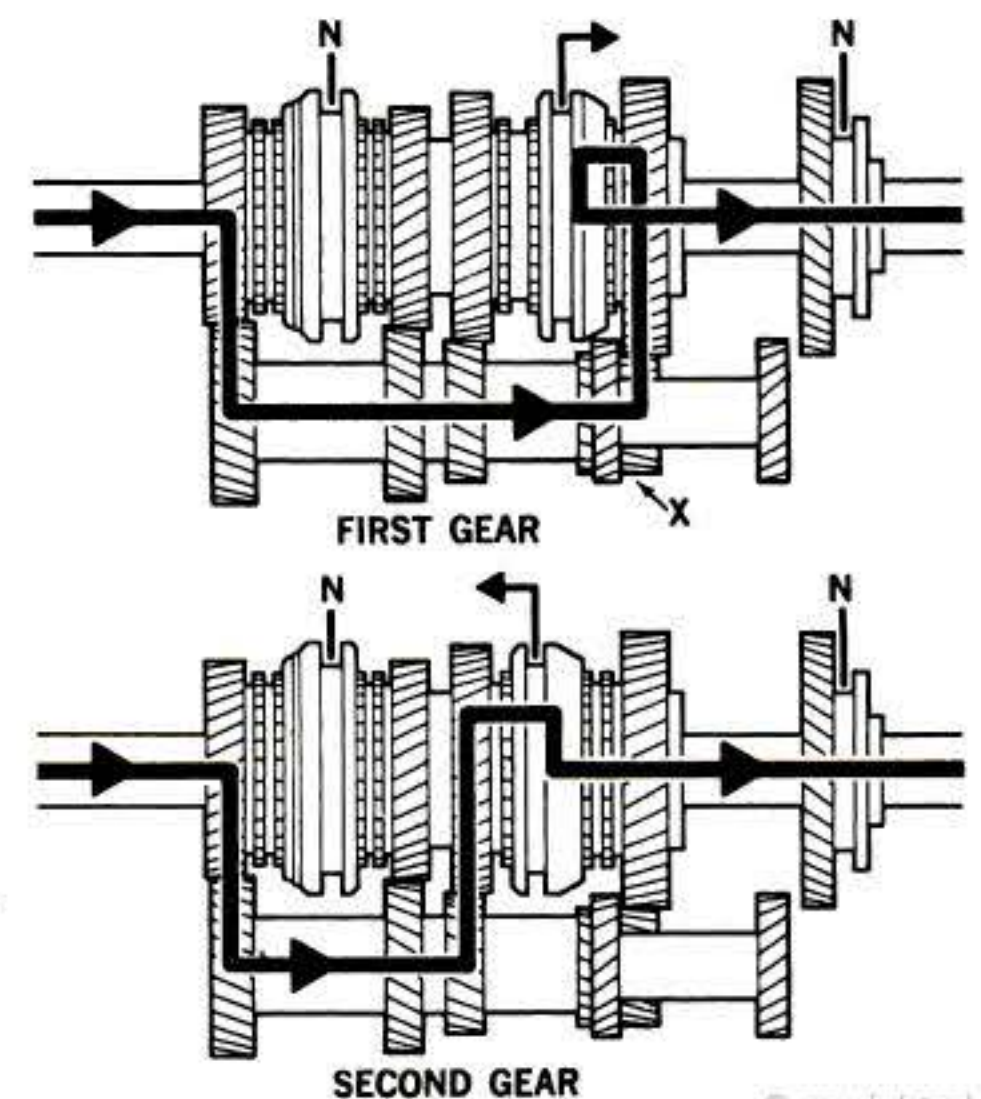
Mechanic B's statement is also correct. If the distributor wire is grounded, it will offer a constant electrical path back to the battery even though the points may be operating normally. This condition will also prevent the test light from coming on.

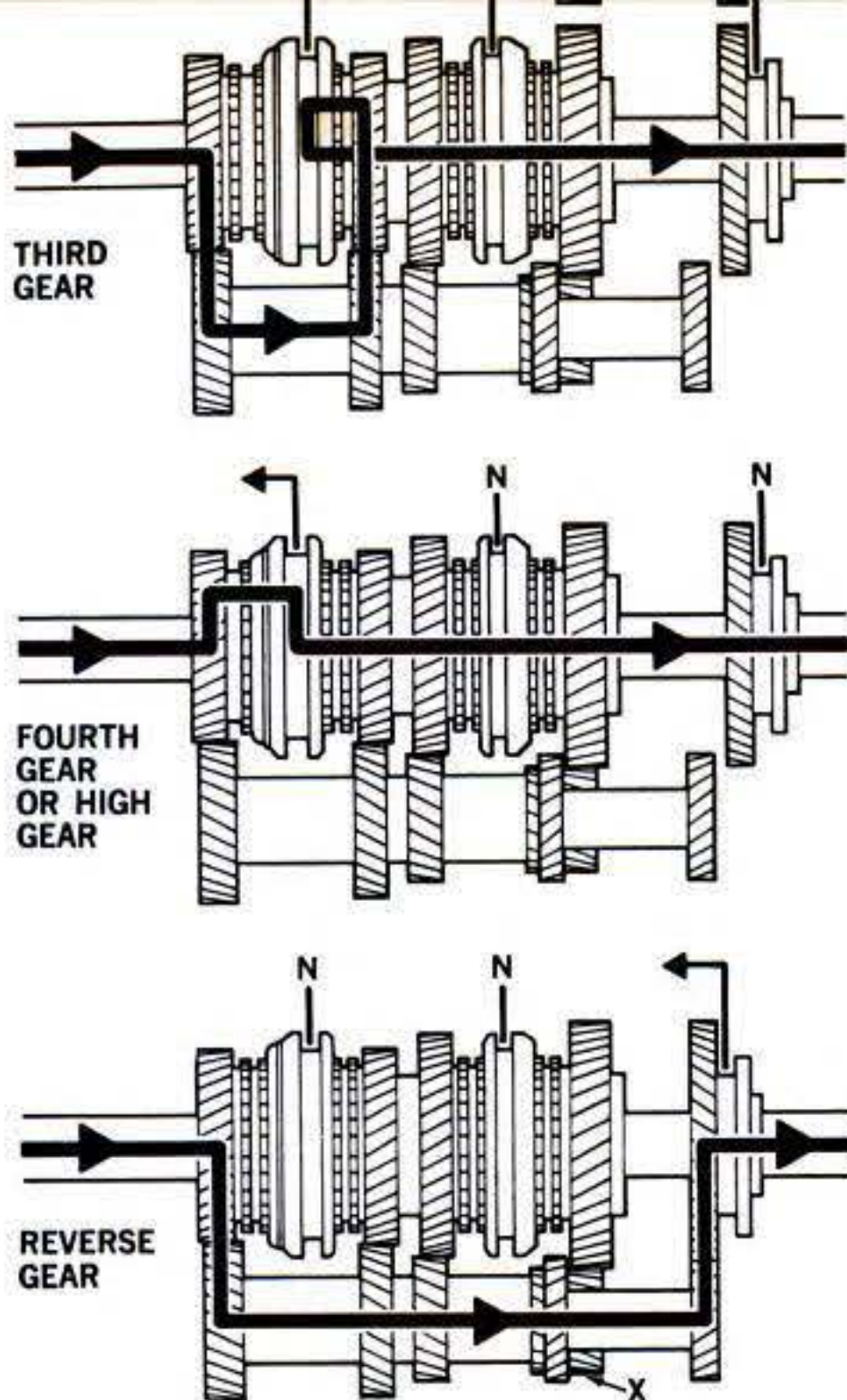
5 Option (D) is correct. By pressurizing hydraulic-fluid passages with air, it is possible to check component operation and determine locations of leaks by listening and watching for signs of escaping air. It should be noted that the removal of the valve-body assembly may also be required to perform these tests.

Option (A) is wrong. A bad filter pickup-tube seal may allow air to be pulled into the transmission pump along with fluid and lower overall hydraulic pressure. But a check of its condition will not help to locate a pressure leak.

Option (B) is wrong. Line pressure can only be checked with the transmission full of fluid and under operating conditions.

Option (C) is wrong. A close inspection of the valve body and its mating surfaces may reveal leaking areas, but there still would be several other possible locations for pressure leakage.





6 Mechanic A's diagnosis is wrong. Power flows through the clutch gear to the counter gear in every gear position except fourth, as shown in these five diagrams. So a broken clutch gear tooth would cause noise in reverse and all reduction gears.

Mechanic B's diagnosis is cor-

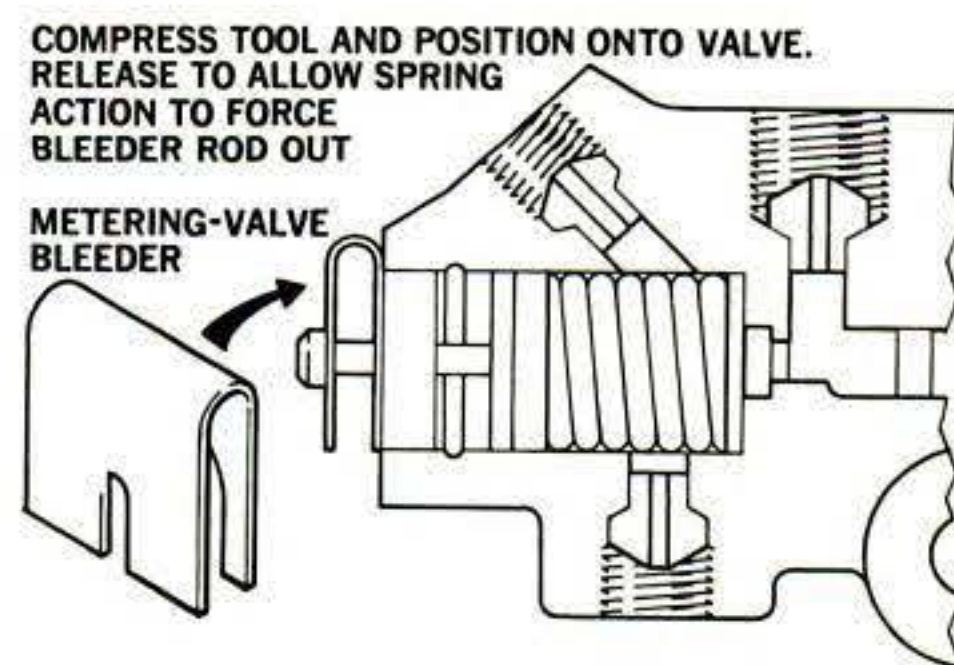
rect. The transmission first-speed gear and reverse-idler gear are both driven by the countergear-assembly first gear (as noted with an X in the corresponding diagrams). When the countergear first gear has a broken tooth, a noise is heard when the transmission is in the first or reverse gear.

7 The device in question is an idle stop solenoid. The solenoid is energized whenever the ignition is turned on, forcing out its plunger against the throttle linkage and slightly opening the carburetor throttle plates. This allows more air to enter the engine during idle, which provides a leaner air/fuel mixture and lowers emissions.

When the ignition is turned off, the solenoid plunger retracts. This allows the throttle plates to close almost completely, preventing air and fuel from entering the engine. If the solenoid is not properly adjusted, air and fuel may enter the engine and be ignited by high cylinder temperatures. This results in dieseling, or after-run.

The incorrect statement, then, is (D). It's the fast-idle cam—part of the choke mechanism—that's re-

sponsible for increasing engine idle speed during warm-up, and not the idle stop solenoid in our sketch.

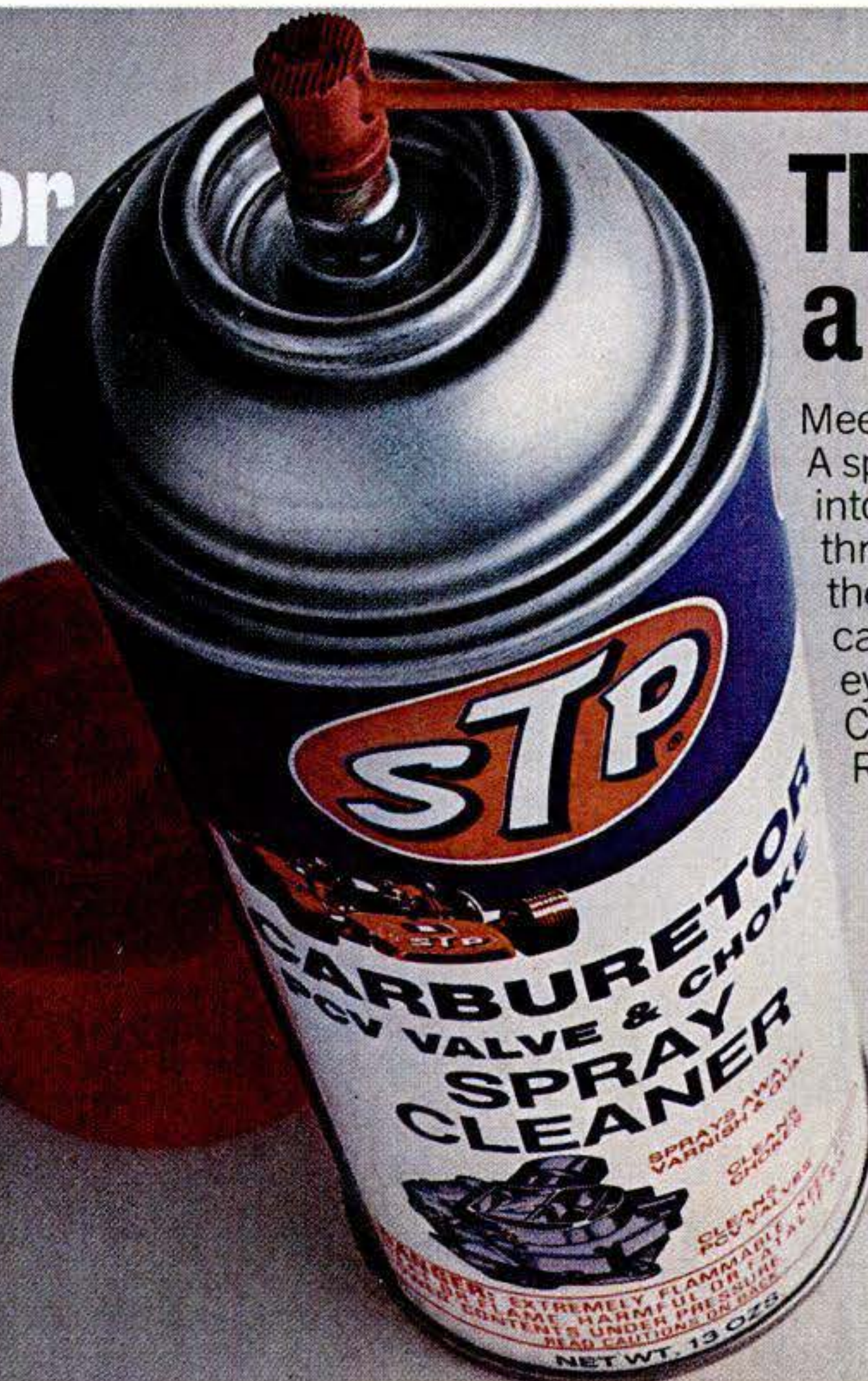


8 Option (D) is correct. The metering valve is located in the front disc-brake hydraulic system. The valve prevents disc-brake operation until the master-cylinder pressure rises to approximately 125 psi. This allows the rear drum brakes to overcome the pressure of the shoe return springs before the disc brakes start to apply. When using a pressure bleeder to bleed the disc caliper, the valve must be overridden by activating a release button as shown above.

Option (A) is wrong. The proportioning valve is located in the rear drum-brake hydraulic system

Continued

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Car-care quiz answers

[Continued]

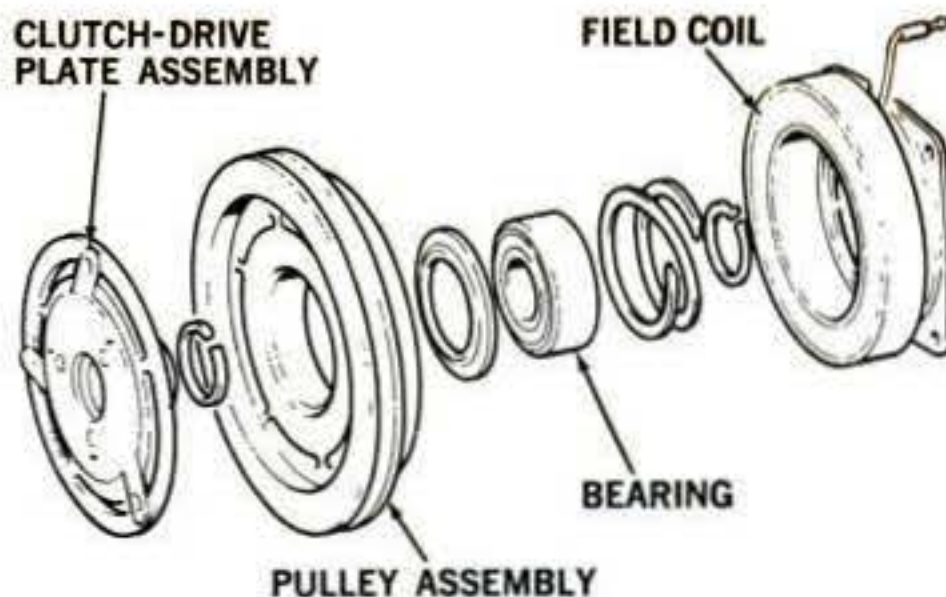
and it prevents rear-wheel lockup. It has no effect on the caliper hydraulic system.

Option (B) is wrong. The pressure-differential valve is located between the front disc and rear drum hydraulic-brake systems. This valve senses pressure differences between the systems and turns on the brake warning light in the event of a system failure.

Option (C) is wrong. As stated in option (A), the proportioning valve has no effect on the caliper hydraulic system.

Usually the metering, proportioning, and pressure-differential valves are assembled together in one valve called the combination valve.

9 Mechanic A's diagnosis is correct. When the compressor-clutch field coil is not energized, the pulley assembly will rotate freely on the clutch bearing, which is the sole support of the pulley's load. Upon turning on the system, the field coil magnetically pulls the drive-plate assembly toward the pulley, locking them together. This



lockup transfers the pulley's load through the drive plate to the compressor crankshaft and its bearings. Thus, a bad clutch bearing will make noise while the clutch is disengaged and be quiet during clutch engagement.

Mechanic B's diagnosis is wrong. When the A/C system is turned off, the clutch pulley is freewheeling and there is no compressor operation. Upon turning on the system, the clutch assembly locks up and starts to rotate the compressor crankshaft. If the compressor bearings were bad, no noise would occur until the crankshaft started to spin—exactly the reverse of the symptoms described.

10 Whenever current is applied to the F terminal of the alternator in the charging circuit shown on

page 121, magnetic fields build up within the alternator's rotor. As the rotor turns, it passes these fields through the alternator stator windings and generates electricity.

When a jumper wire is connected from the battery terminal to the field terminal of the alternator, you bypass the voltage regulator circuit (which governs alternator output by controlling field strength) and fully energize the rotor field, causing maximum output. This is a simple test used to determine if the system failure is caused by the regulator and its circuit or by the alternator.

Mechanic A's diagnosis is wrong. A bad alternator stator winding would prevent alternator output whether the voltage regulator circuit was operational or bypassed.

Mechanic B's diagnosis is correct. The test indicates a fault in the voltage-regulator circuit. A failure in the circuit between the ignition and voltage regulator would stop current from getting to the alternator field terminal, preventing charging. A bad regulator as well as an open between the regulator and alternator field terminals could also be causes of this condition. **PS**

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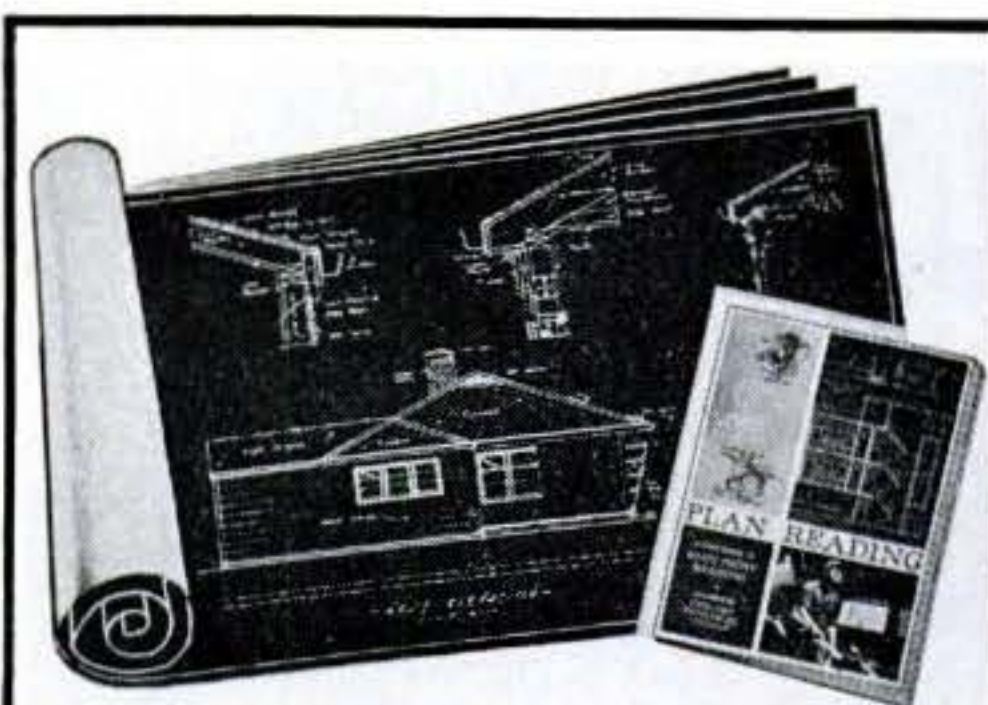
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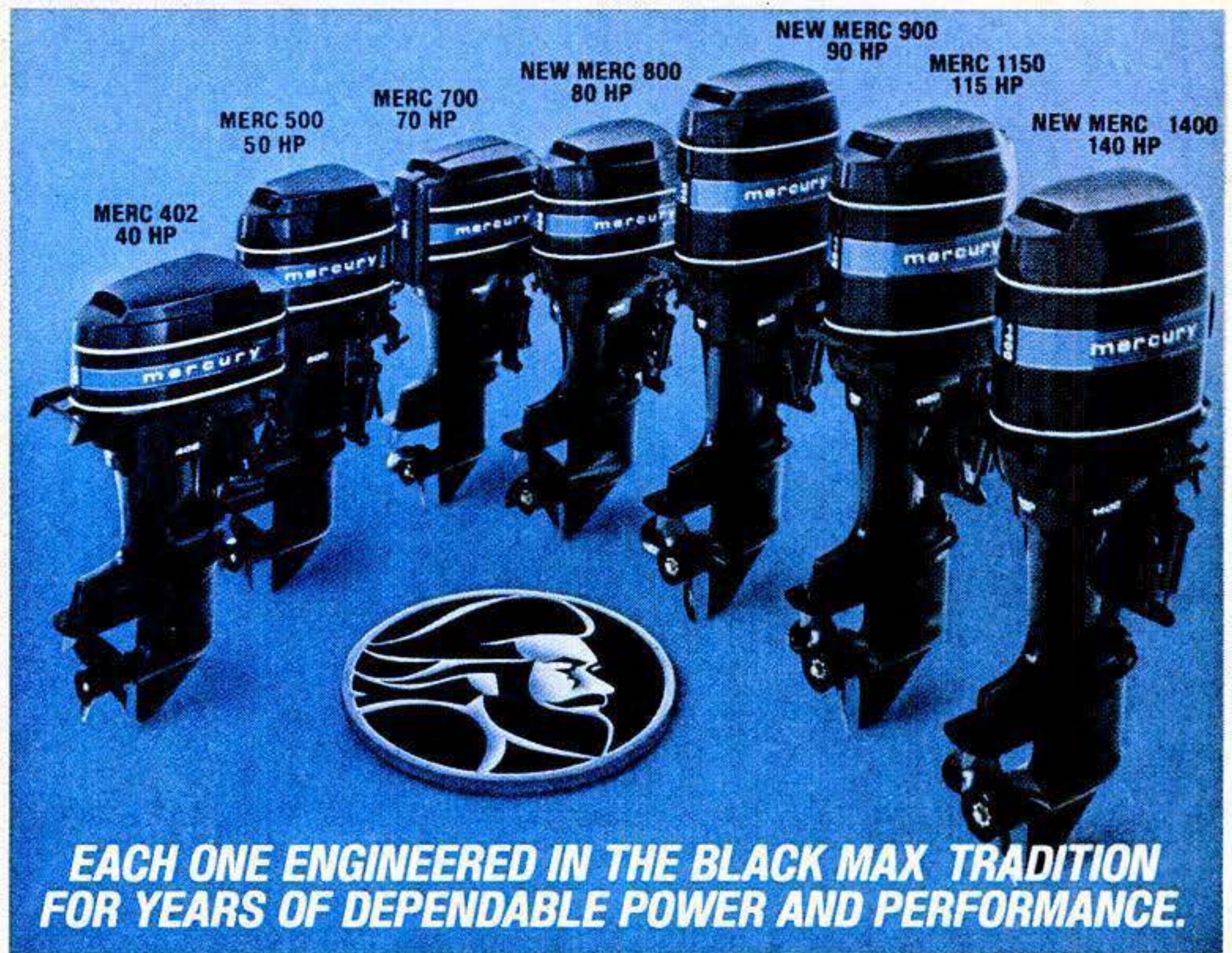
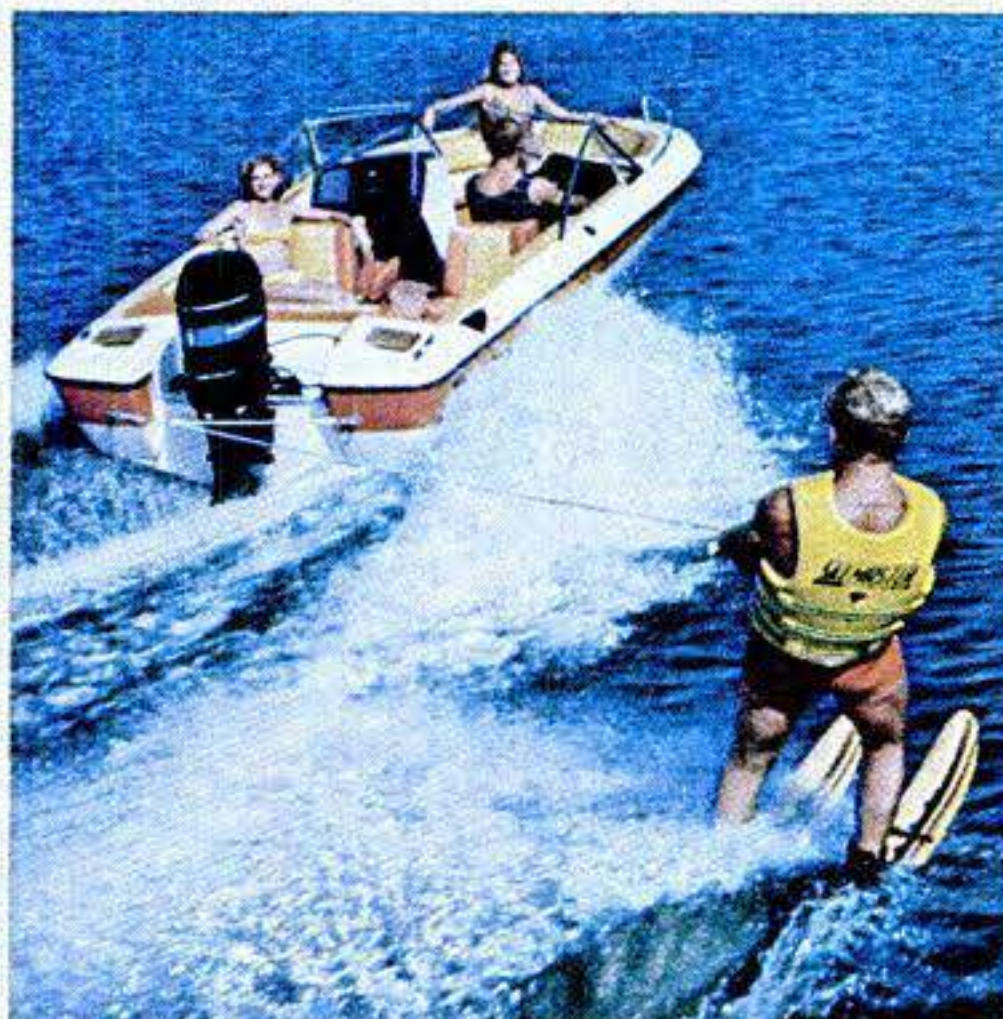
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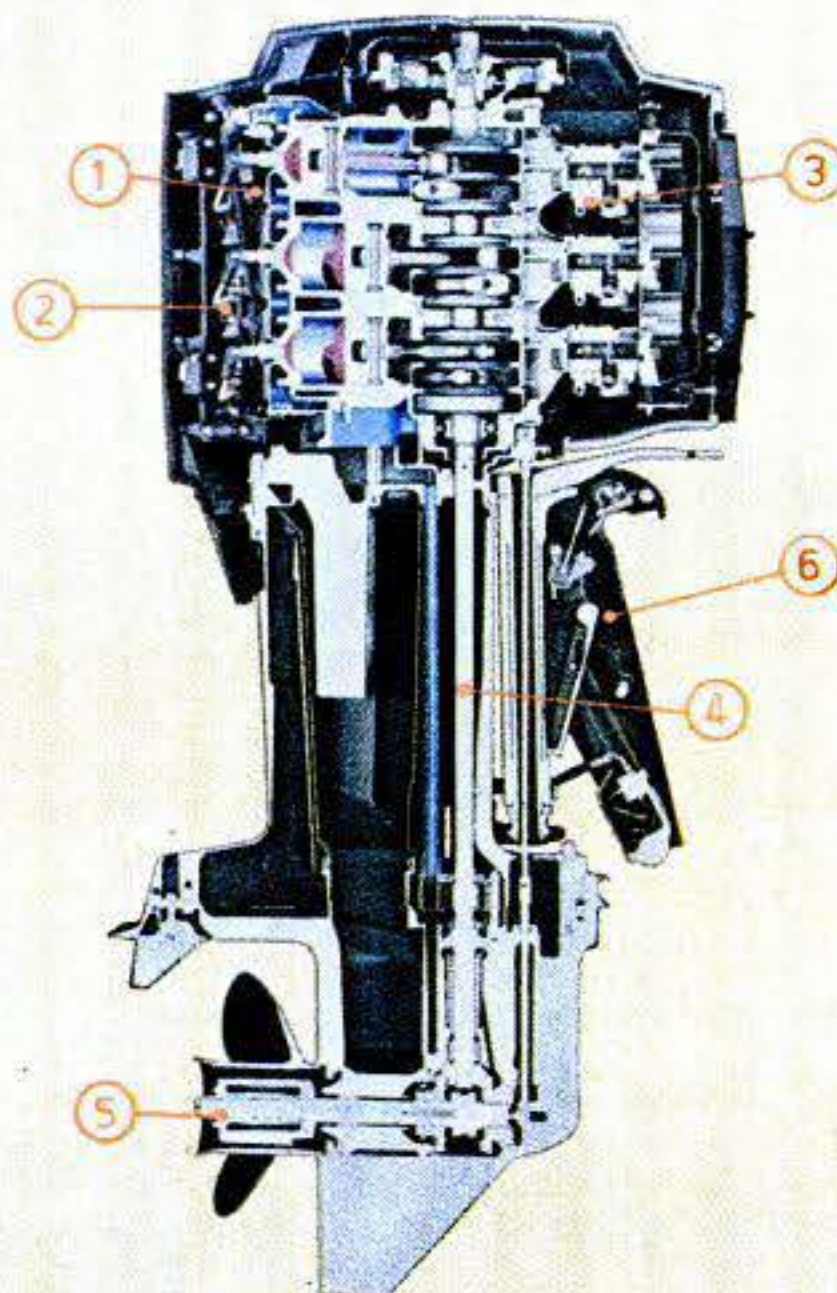
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Help for inventors

[Continued from page 94]

center helped the inventor find someone to produce the idea and fully expected it to succeed. But it didn't.

"The licensee, the guy who picked up the technology, blew it," says Udell. "He just didn't know how to market it, and a good product went down the tubes. We still think it's a darn good idea and may try again with it."

Now that the evaluation system has become self-supporting, the center is trying to expand the kind of assistance it offers. A recently hired technology-transfer specialist will take on the job of finding corporate customers for promising inventions. And the center now prepares a promotional package that presents an invention in a business-like manner (see montage).

Local help available

Because of its limited manpower, says Udell, the center can only offer further assistance to between 10 and 15 percent of the promising ideas it evaluates. To keep those other good inventions alive, the Innovation Center has now enlisted backup support from the Small Business Administration, which has 400 Small Business Institutes (SBI) scattered throughout the country.

Usually university-based operations, these institutes provide management and technical assistance to people trying to start—or save—their own businesses. According to the agreement with the Innovation Center, the institutes will now extend these services to inventors trying to develop an idea into a marketable product. Udell explained: "Say we get an idea from Newark, N.J. After we do the evaluation, we send the guy to the SBI program at Rutgers University. The people there work out some kind of an arrangement to give the inventor some assistance. This puts help right in an individual's backyard and makes it a lot easier than having to deal with someone 2000 miles away."

Giving the lone inventor a better break is not just a matter of preventing a quaint American character—the slightly eccentric basement tinkerer—from passing out of existence. Some of the most important leaps in technology have come from these tinkerers. After all, it wasn't a corporation that came up with the telephone, the light bulb, and the airplane.

P 5

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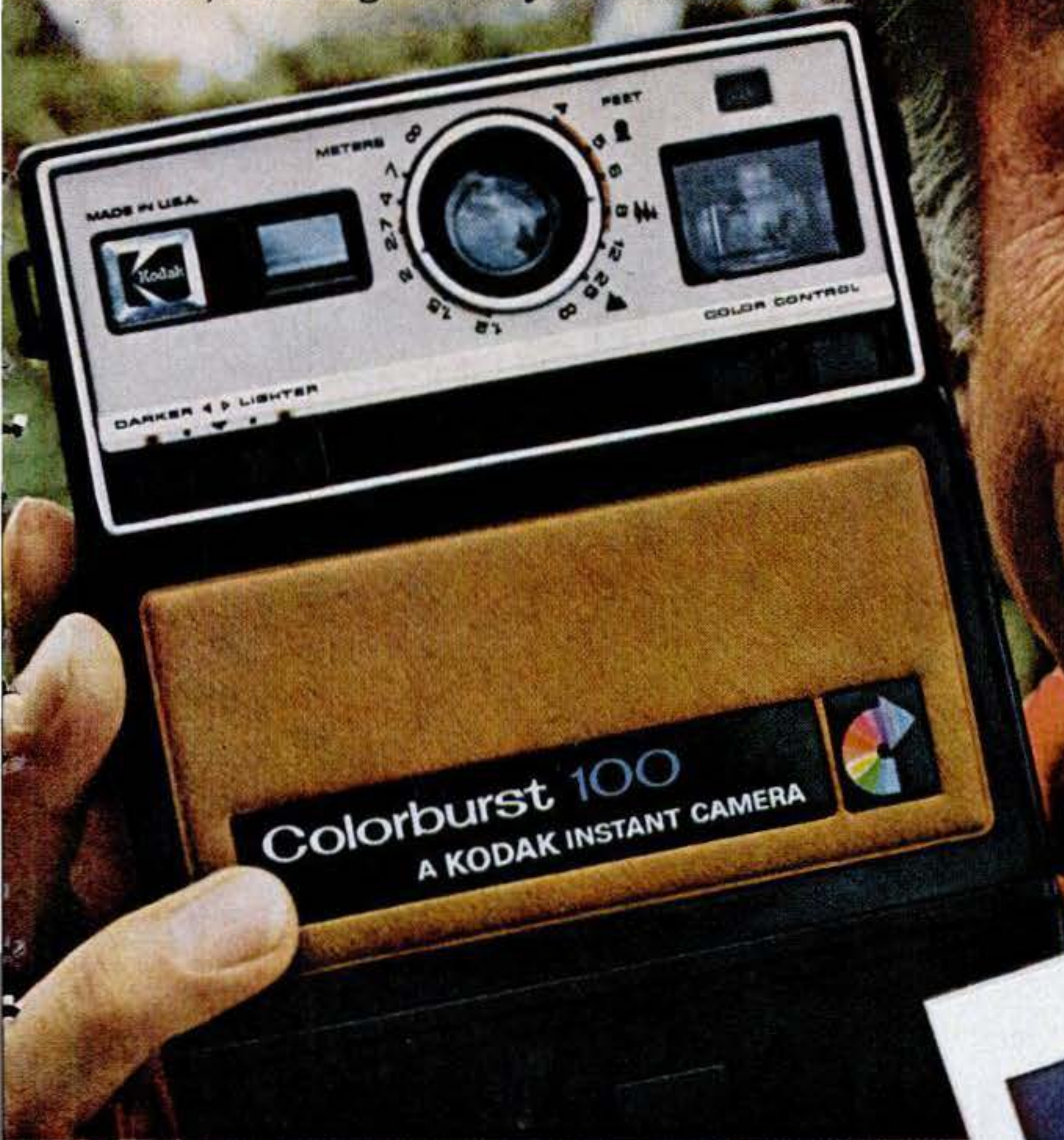


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The 200—with protective lens cover

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Honda portable generator scales Mt. Everest without skipping a beat.

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One thing the American Bicentennial Everest Expedition had along was a Honda EM-400 portable generator. At the 18,000-foot base camp, the little Honda put out dependable power for charging batteries, running a soldering iron—even powering the radio to keep up vital communications.

The EM-400 puts out 400 watts (max. rating) of AC power; it'll power

small tools and accessories around the home or campsite. It also puts out 12 volts of DC power, so it will charge your car battery as well. It's simple to use; the quiet Honda engine is a four-stroke design so you never have to pre-mix fuel. And at a mere 39 pounds, it's easy to store and move.

Check out the Honda EM-400 at your Honda generator dealer today. It's a nice companion to have, whether you're climbing a mountain or just getting the odd jobs done at home.

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For optimum performance and safety we recommend that you read the owner's manual before operating the unit. For the Honda dealer nearest you, call collect (213) 381-2201. Honda also makes a line of tillers, outboard engines, general purpose engines and water pumps. © 1978 American Honda Motor Co., Inc.

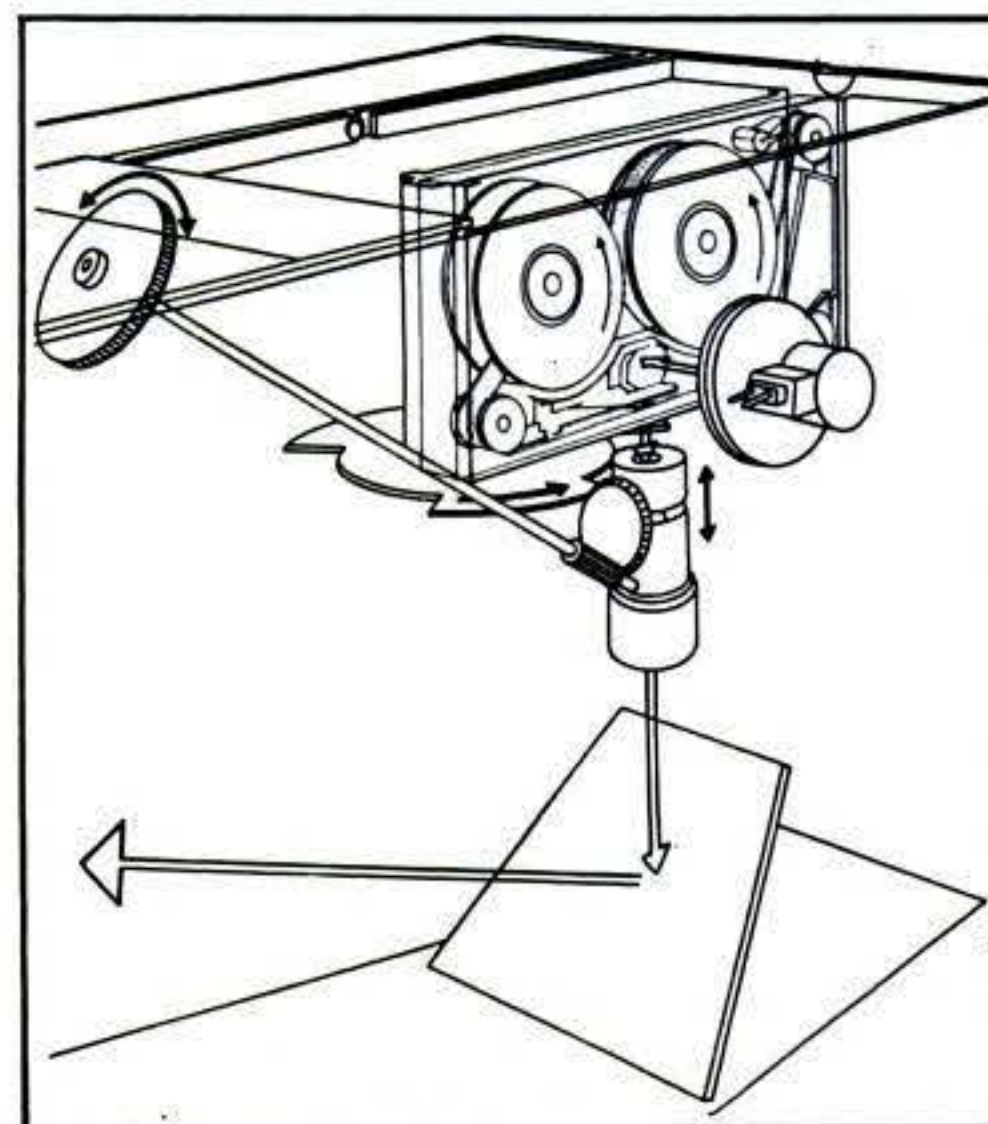
Making instant movies

[Continued from page 106]

Two accessories are almost necessities. The Twi Light, a two-lamp light, makes it possible to shoot under any light conditions. And an Instant Replay enables you to wind back the film in the player to replay short scenes.

With that home camera, the small screen, and the instant-replay facility, doesn't this sound like video? It does, even to Dr. Land, who calls his cassette the Polavision Phototape Cassette. But Polavision has some advantages: At \$699 (\$184 for the camera, \$515 for the player), plus \$9.95 for each cassette, the system is far cheaper than a video-cassette system, and the margin widens dramatically if you compare it with color video. The Polavision camera is a lightweight 1½ pounds, and is its own "recorder." Contrast that with a bulky color camera with a separate cassette recorder. Contrast, too, the ease of use of Polavision with the complexity of color video.

I find, too, that the 2½ minutes of film time that the Polavision cassette offers is just about right as an entertainment module. Just about the time you've finished the last eight-second take of Jim Marshall carving the turkey or Joe Sweeney raising his glass in yet another toast, you get pretty anxious to see what it looks like. And if your friends and relations are like mine, you'll probably find that they're anxious, too, and have beaten you to the player. **PS**



Inside the player: Light from lamp is beamed through cassette's prism, film, and player's aperture block to lens. Image, projected onto mirror, is then reflected to viewing screen—two complexly molded plastic sheets that collect and distribute light evenly and efficiently so image can be viewed in lighted room.

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Caravan has hundreds of local chapters and Caravan members get discounts on magazines, RV accessories and other nice things.

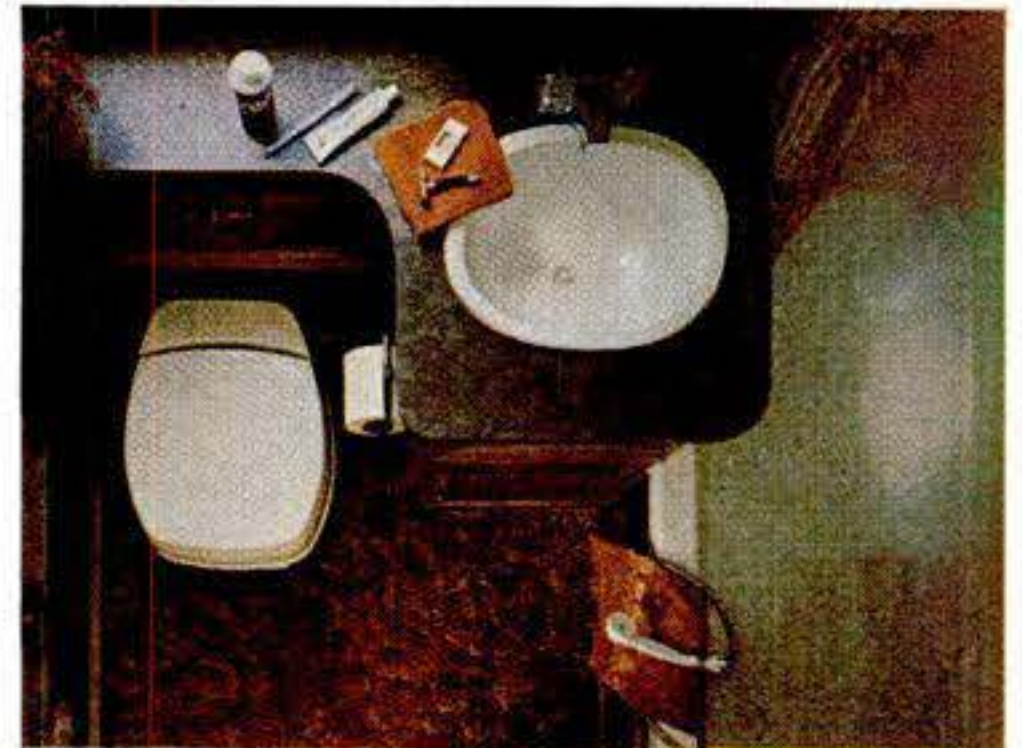
5. Our modest prices.

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PS readers talk back

[Continued from page 4]

water heater often goes into heating one's house in the winter. This, of course, depends upon where the hot-water heater is located, but in our house it is in a heated utility room. The only saving from insulating the tank would come during the summer.

Niel E. Nielsen, Summit, Ill.

Belated corrigenda

In the "Lifting Foils" article [Feb.] some text was apparently dropped where the story jumped from page 73 to 168. And a line on page 168 says, "the experimental model easily generated 15 watts." Isn't that a mistake? Surely it generated more power than that.

Dr. Vernon S. C. Wier, Merced, Calif.

The two errors in Dr. Wier's copy found their way into a very early press run, but were soon corrected. The maimed sentence should read: "Eighty percent of the rivers in the U.S. are in plains or valleys, and the customary approach of building high dams to create high heads is not only expensive, but floods vast areas of valuable land." And the 15 watts should be 15 kilowatts.

I thoroughly enjoyed Mr. Langa's article "Wood as Fuel." It is too bad that you decided not to print page 150 and the rest of the article. How about giving us another chance?

S. W. Coe, Longview, Tex.

The continuation of the story appears on page 154. Again, most copies have it right.

Btu of wood

Okay, so I bought a wood-burning stove after your October '76 "Wood as Fuel" article. The table proclaimed 21.3 million Btu per cord (air dried) for red oak. Now your new "Wood as Fuel" article [Feb. '78] tells me that red oak, at best, has only 12.6 million Btu per cord. Quite obviously Messrs. F. S. Langa and A. J. Hand did not collaborate. Who's right?

R. E. Robinson, Huntington, N.Y.

Both are right, but they are talking about different quantities. Mr. Hand's table in the October '76 article gives the total heat produced by burning a species of wood, while Mr. Langa's figures (February) refer to useful heat—those Btu that actually get into your home. Since modern wood stoves are around 55 percent efficient, they'll deliver a little more than half the Btu that are theoretically available.

Correction: In the "Stereo Receivers" article [April] an error appears in the box on page 70. The sentence reads: "The reference for 0 dB chosen is one femtowatt, or 1×10^{-15} watts." The figure should be 1×10^{-15} watt.

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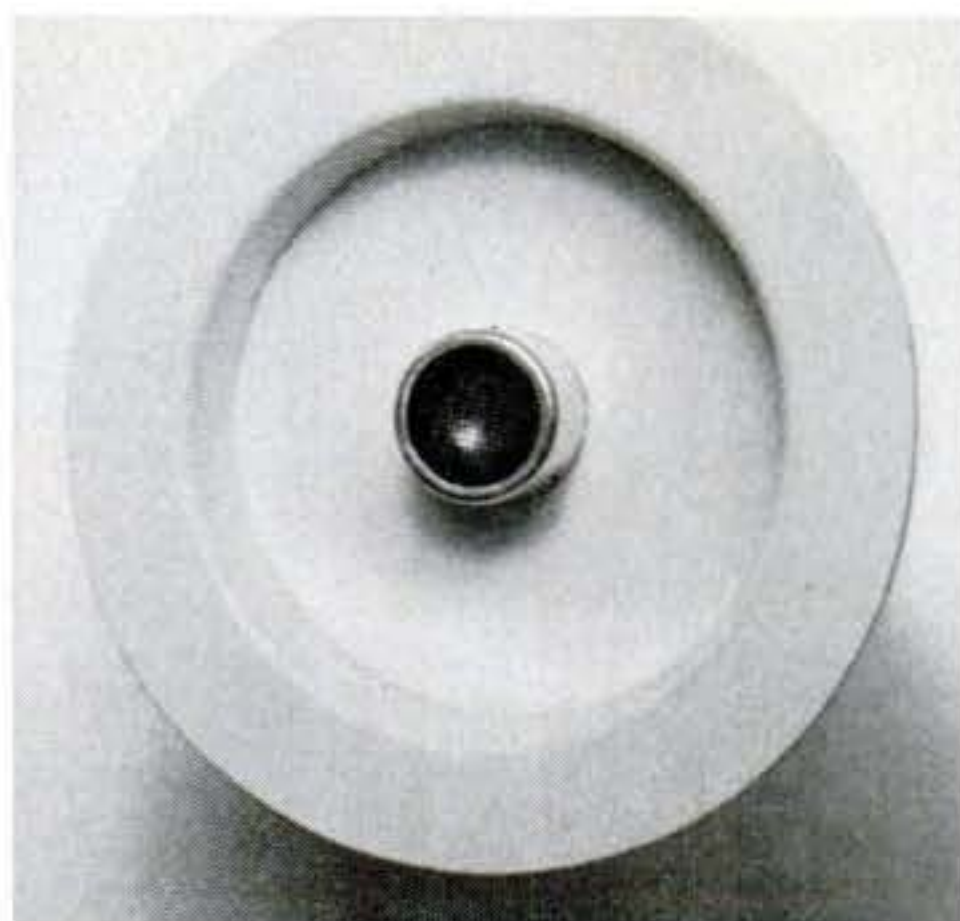


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Ultrasonic "light switch" saves energy

I walked into a vacant office of a New York Citibank building and—instantly—the lights went on. It's not that I'm naturally dazzling; the room is monitored by an electrical switching system known as EASE (Energy Activation Systems Equipment) that uses ultrasonics to "sense" human motion.

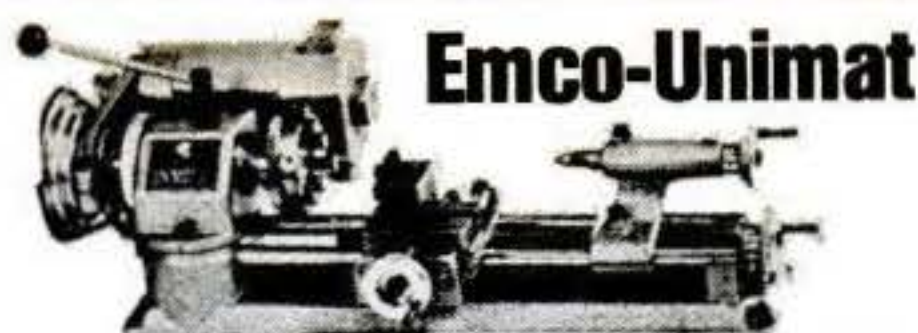
With EASE installed, lights, TV's, and air conditioners automatically go on when a person enters, and off (after a few minutes' delay) when the person leaves. With power flowing only when it's needed, EASE can save energy—and money—for its users.

EASE has two centralized components: an oscillator, which generates frequencies of 42 kHz, and a low-voltage (24 VDC) power supply. The oscillator powers an air coupler that acts like a hi-fi speaker to flood the area with inaudible sound waves. Sensors, controlled by the central power supply, sense the disturbance in sound pattern that occurs when a person enters or leaves the area. A switching module then opens and closes standard lighting relays. Only the small, ceiling-mounted air couplers and the sensors centered within them (see photo) are visible.

Citibank paid 75 cents per sq. ft. to install EASE on part of one floor. Its light bill has since gone down by 33.7 percent, I was told.

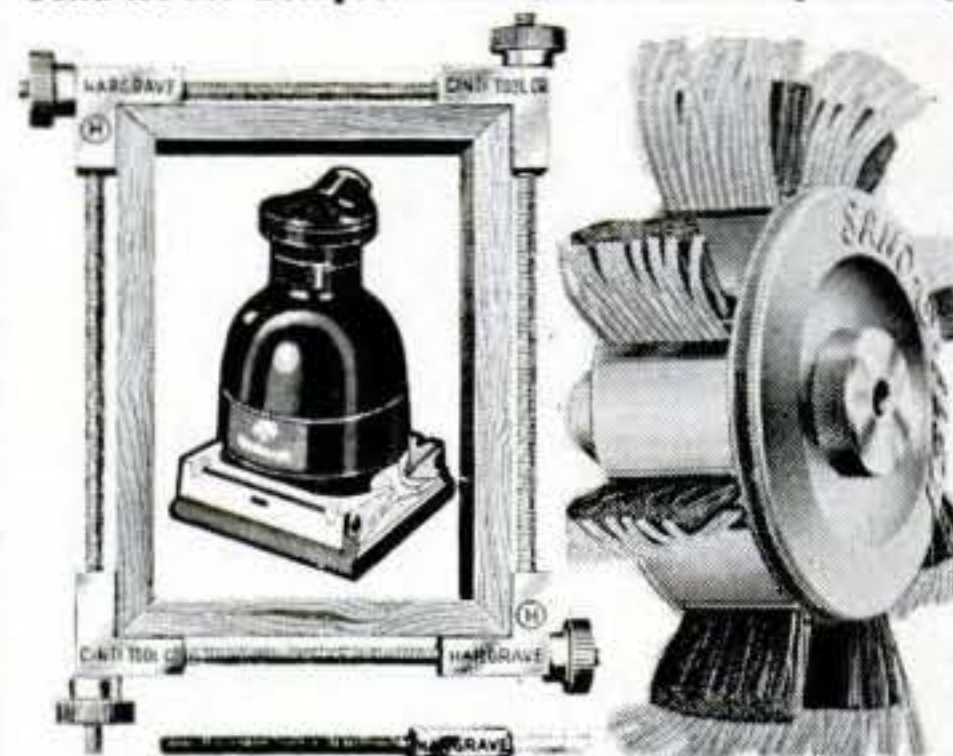
Although EASE was designed primarily for large users of electric power, such as office buildings, museums, and hotels, Charly Barnum, president of MRCA, Inc. (117 Ft. Lee Rd., Leonia, N.J. 07605), says: "We're working on making the system suitable for homeowners. It could be available in a year or less."

—Katherine Griggs



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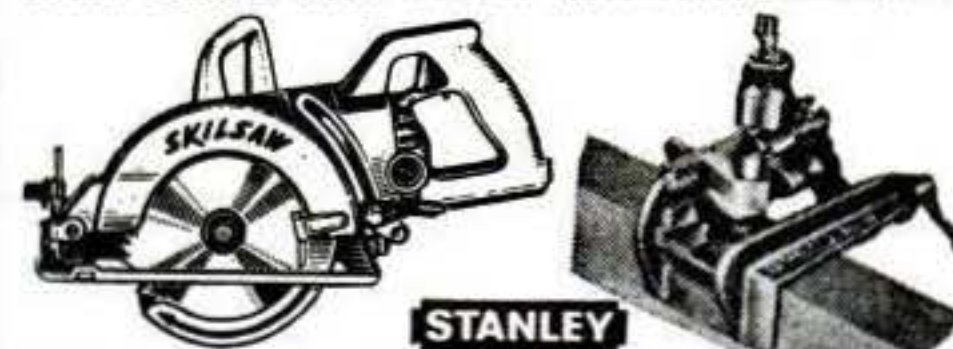
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35-M2 Sand-O-Flex Sander\$17.98



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A78-13	17.88	1.69	H78-14	27.88	2.60
B78-13	19.88	1.77	5.60-15	20.44	1.73
E78-14	23.88	2.13	G78-15	27.88	2.45
F78-14	24.88	2.26	H78-15	28.88	2.65
G78-14	25.88	2.42			

Sentry Bias-belted Blackwall Tubeless					
Size	Price	F.E.T.	Size	Price	F.E.T.
A78-13	22.88	1.71	G78-14	32.88	2.47
B78-13	25.88	1.82	G78-15	32.88	2.55
E78-14	28.88	2.19	H78-15	34.88	2.77
F78-14	30.88	2.34			

Sentry Bias-belted Whitewall Tubeless					
Size	Price	F.E.T.	Size	Price	F.E.T.
A78-13	24.88	1.71	H78-14	36.88	2.70
B78-13	27.88	1.82	G78-15	34.88	2.55
E78-14	30.88	2.19	H78-15	36.88	2.77
F78-14	32.88	2.34	L78-15	39.88	3.05
G78-14	34.88	2.47			

Sentry Radial Blackwall Tubeless					
Size	Price	F.E.T.	Size	Price	F.E.T.
155R-12	29.88	1.52	165R-15	29.88	2.07
165R-13	29.88	1.84			

Sentry Radial Whitewall Tubeless					
Size	Price	F.E.T.	Size	Price	F.E.T.
AR78-13	34.44	1.84	GR78-14	48.44	2.65
BR78-13	37.44	1.95	HR78-14	51.44	2.82
DR78-14	39.44	2.25	GR78-15	48.44	2.75
ER78-14	41.44	2.36	HR78-15	51.44	2.94
FR78-14	44.44	2.51	LR78-15	53.44	3.22

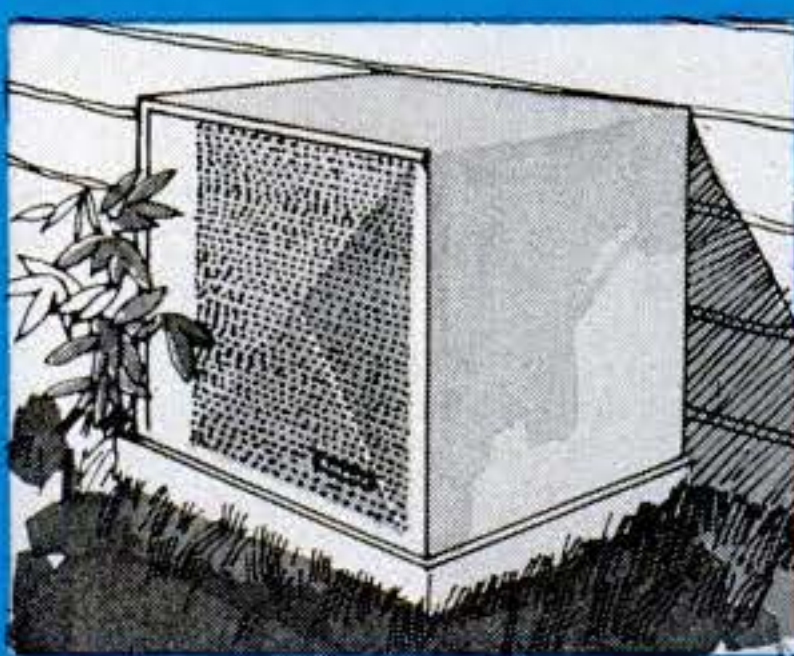
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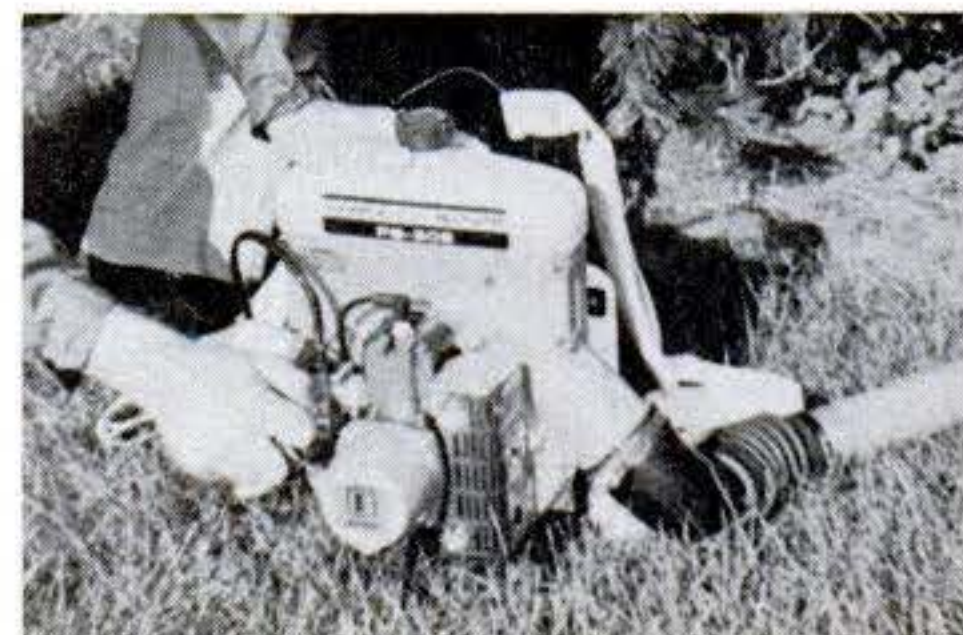


Lightweight backpack blower

After trying Echo's new smooth-running and amazingly easy-starting little backpack blower, I'm impressed by just how many jobs it can do—and as quickly as you can scurry about. In nothing flat you can blow out rain gutters, swish debris from driveway, patio, or pool areas, blast dust and dirt from porch crannies and garage, and move leaves from hard-to-rake places into neat piles. A probing jet of air at 197 ft./sec. does it all. It has a two-pint tank.

The PB-202 blower does not have quite the ripping, tearing power of the larger industrial model, but it's adequate for getting under evergreen needles, leaves, or packed grass. In fact, for a lot of jobs you'll want to switch down the throttle to reduce power.

The little 21-cc, air-cooled engine (below) has typical Kioritz smoothness and quietness. Its lightness and vibration isolation make it comfortable even when you're working from a ladder. It costs less than \$200. Maker: Echo Chainsaw Div., Kioritz Corp. of America, 350 Wainwright Ave., Northbrook, Ill. 60062.—E. F. Lindsley



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Storing your snowthrower

When you're lying on the beach this summer, you won't remember last January's snows—unless the thought of a neglected snowthrower haunts you. The people at Toro—manufacturers of a full line of snowthrowers, including the model shown—passed along this checklist for proper out-of-season storage.

- Drain the fuel tank and start the engine to clear the carburetor and fuel lines. The resin that is left when stored fuel evaporates will otherwise plug the carburetor's small openings.

- If your machine has a crankcase (two-cycle engines don't), change the oil.

- Grease and oil all points noted in the manual. Remove the spark plug and pour one tablespoon of engine oil into its hole (or two tbsp. for larger 5-10-hp machines) to put a protective oil coating on cylinder walls. To distribute the oil, slowly pull the starter rope.

- Putting in a new, properly gapped spark plug—either now or next fall—is cheaper and easier than regapping last year's plug.

- Don't wait for the first winter storm. Replace all damaged or missing parts now.

- Hose down the snowthrower, using soap if necessary. Don't use solvents. They might damage paint.

- Use touch-up paint to help prevent rust and also to give metal parts a smooth, non-stick surface.

- Store and cover the machine in a clean, dry area. Put heavier models on blocks to remove weight from tires.—*Jane Kleintob*

Colonel Taylor never found a yeast good enough for his Bourbon till he cultivated it himself.

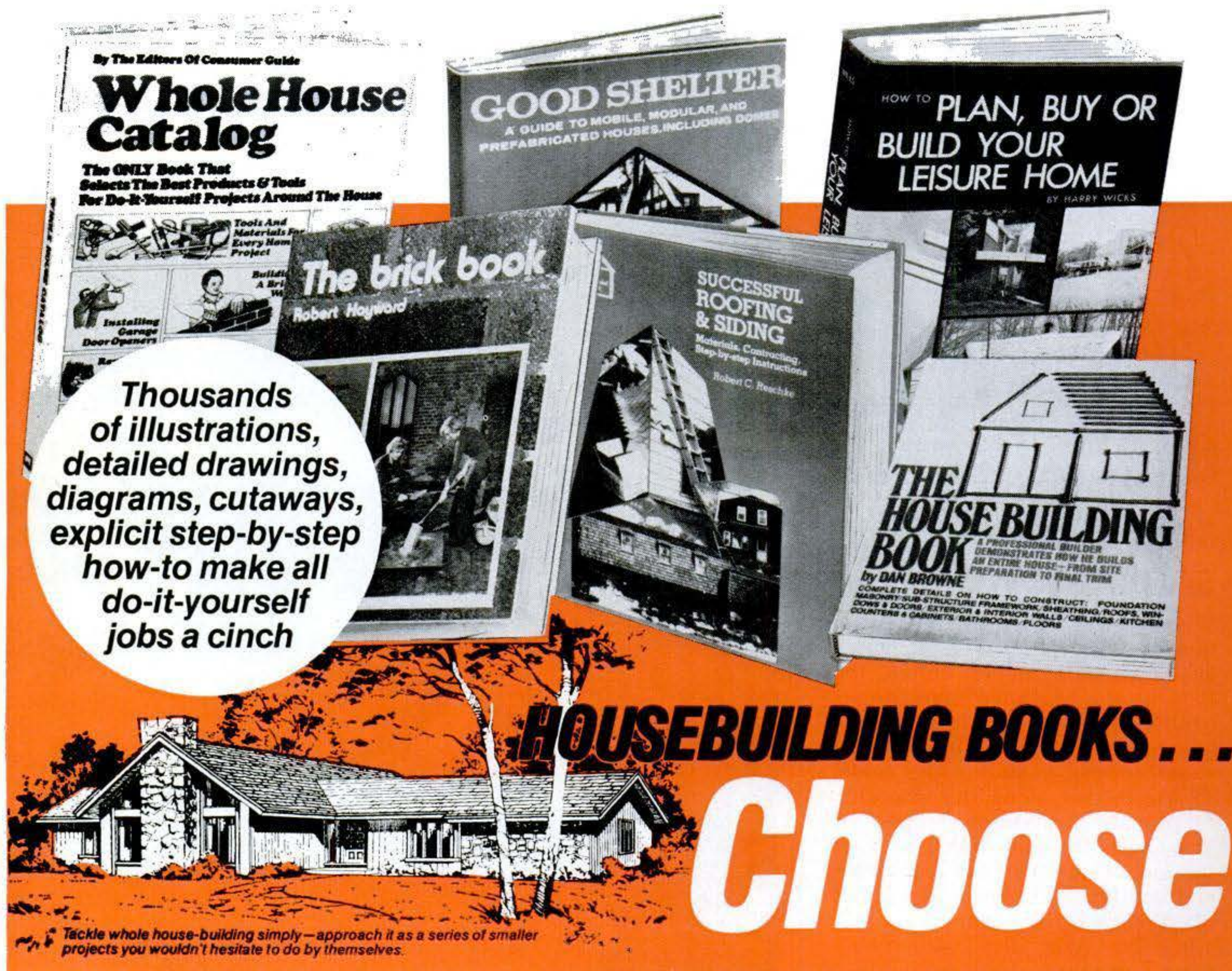
No step in the making of great Bourbon was unimportant to Colonel Edmund H. Taylor, Jr. He personally cultivated the yeast that started his choice grains on their way to becoming Old Taylor. We still make Old Taylor the painstaking way Colonel Taylor did. The yeast we use today is the same yeast he cultivated. That's one reason Old Taylor is so gentle and satisfying.

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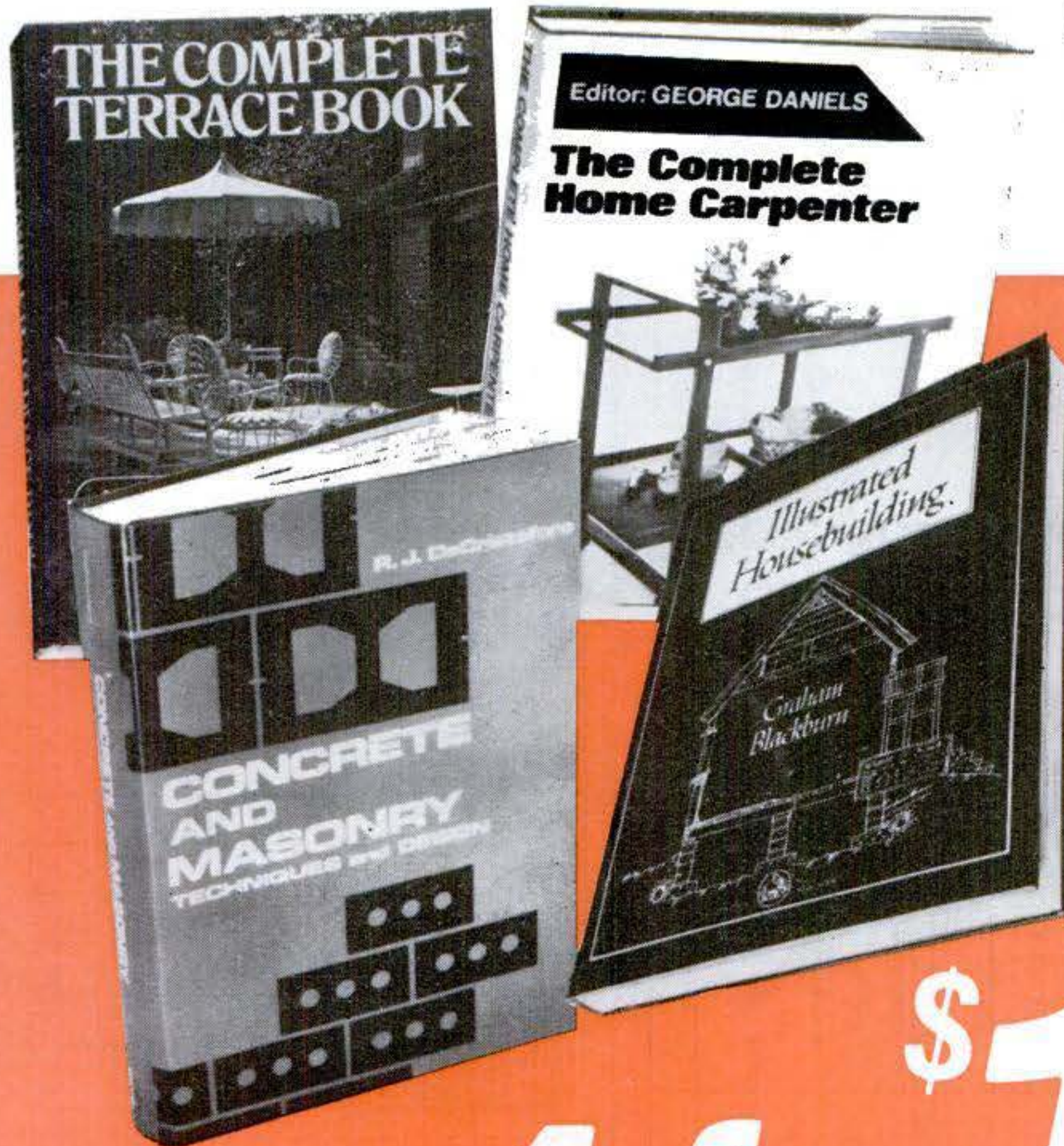
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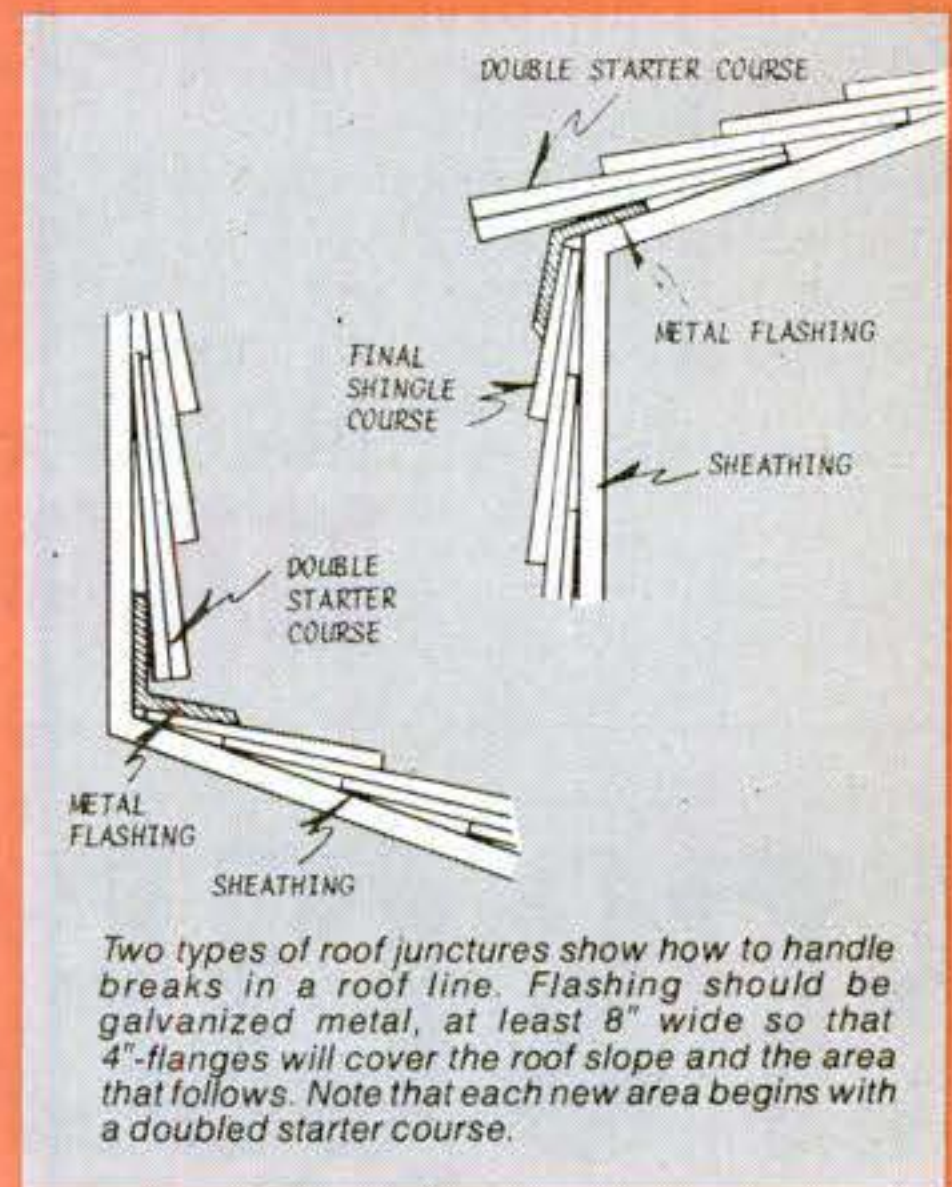
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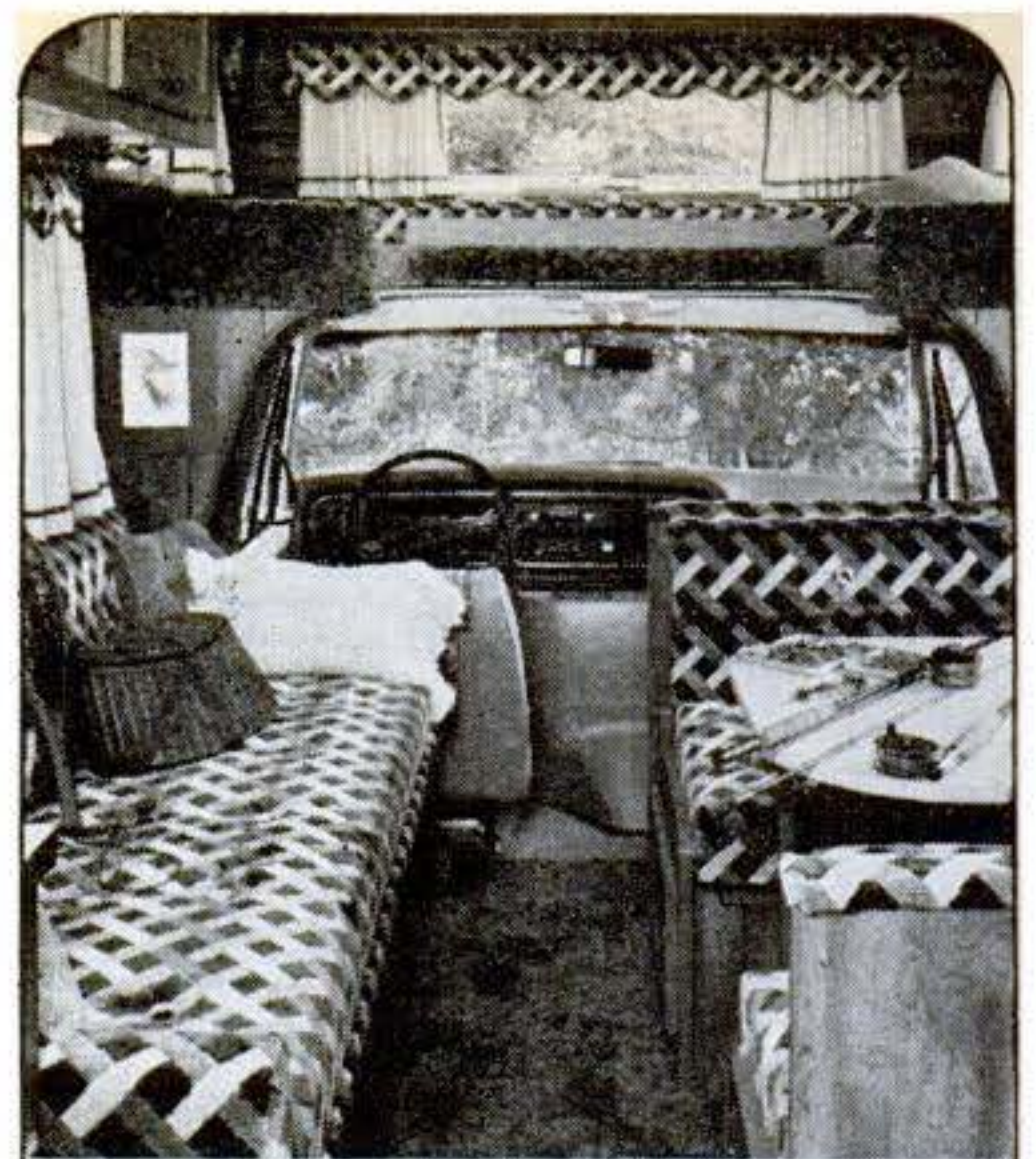
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These questions used to really stump us. That was just a few years ago.

My wife and I then lived in Denver, Colorado, at 2545 South High Street. We paid \$135 a month rent for a cramped, tumbled down house. My wife was expecting our second child and we were flat broke. I felt desperate and forced into a corner. I had to borrow \$150 from my father and another \$150 from my father-in-law just to buy the groceries and pay the rent. If that wasn't enough, we were several thousand dollars in debt.

Things are much different now. Last year I could have retired and lived off the income of my one million dollars in real estate holdings. (Incidentally, almost all of the income from the real estate is tax free.)

Since I had worked 20 to 40 hours a week, I know that I didn't work even 10 times longer or harder than you. And with my C-average from Ames High School (located in Ames, Iowa). I did a little better later on but I soon realized that a salaried job was not the way to become financially free. If you'll stop and think, you'll realize that millionaires do not work 10, 20, or 50 times harder or longer than you.

If hours, efforts or brains are not what separates the rich from the average guy who is swamped with debts and very little income then what is?

I learned the answer to that question from an old fellow in Denver. This fellow worked in a drug store stocking the shelves. Very few people knew that he had \$200,000 in the bank, all of which he had earned starting from nothing.

Within a year after meeting him, I was told and shown the same thing by a young man who had recently earned over a million dollars. By this time, I began to realize that what I was being shown was truly a remarkable and workable way to grow rich.

I began to apply the principles and methods I had been shown. The results were



Mark Haroldsen spent four years perfecting a "wealth formula" and became a millionaire in the process. More than 150,000 people have discovered how his methods can lead them to total Financial Freedom.

amazing. I couldn't believe how easy it was, in fact it seemed too easy.

But then I met an elderly lady (83 years old) who, although not very smart, has made \$117,000 using the same formula.

I then figured my beginning wasn't luck. For three and one half years, I worked hard to refine and improve on the formula that I had been shown, so that it would be easy to get quicker results.

As I did this, my assets multiplied very rapidly (160% per year) to the point that I didn't have to work any longer.

I guess I am bragging now, but I did start spending a lot of time in our back yard pool, traveling around the country, and doing a lot of loafing.

Then one day a friend asked me how he could do what I had done.

So I began to outline the formula that I had improved to show him really how simple it was, and how he could do the same thing.

By the next time he approached me, I had written almost a complete volume on the easy way for him to copy my results.

I wrote this in simple, straight forward

language so anyone could understand it.

This time my friend's questions were very specific. (He had already begun buying properties with the formulas I had been giving him). Now he had a property he wanted to buy, but was out of cash. How could he buy it?

I not only showed him how to buy without cash, but by the time the deal was complete, he had \$5,000 cash in his pocket to boot.

I also showed him how to buy a \$26,000 property for \$75 down.

You, or anyone, can do exactly what I did, or my close friends have done, in fact, you may well do it better. (I began doing this in my spare time only.)

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- Put \$10,000 cash in your pocket each time you buy (without selling property).
- Double your assets every year.
- Legally avoid paying federal or state income taxes.
- Buy bargains at ½ their market value.
- Allow you to travel one week out of every month.

When you send me a check or money order for \$10, I will send you all my formulas and methods, and you are free to use them anywhere and as often as you would like.

Now if you were a personal friend of mine, I know you would believe me and not need any kind of guarantee, but since you don't know me personally, I will guarantee that you will be completely satisfied and that my formula will work for you if you apply it. I will back up that guarantee by not cashing your check for 30 days, and if you for any reason change your mind, let me know and I will send your uncashed check back.

You may ask, why am I willing to share my formula for wealth? Well, simply because those of you who order my material will be helping to increase my net worth.

You shouldn't care if I profit as long as you profit. I guarantee that you'll be satisfied that my methods will help you or I'll send your money back!

By the way, if you feel a little uneasy about sending me a check or money order for \$10.00, simply postdate it by 30 days which will completely eliminate your risk.

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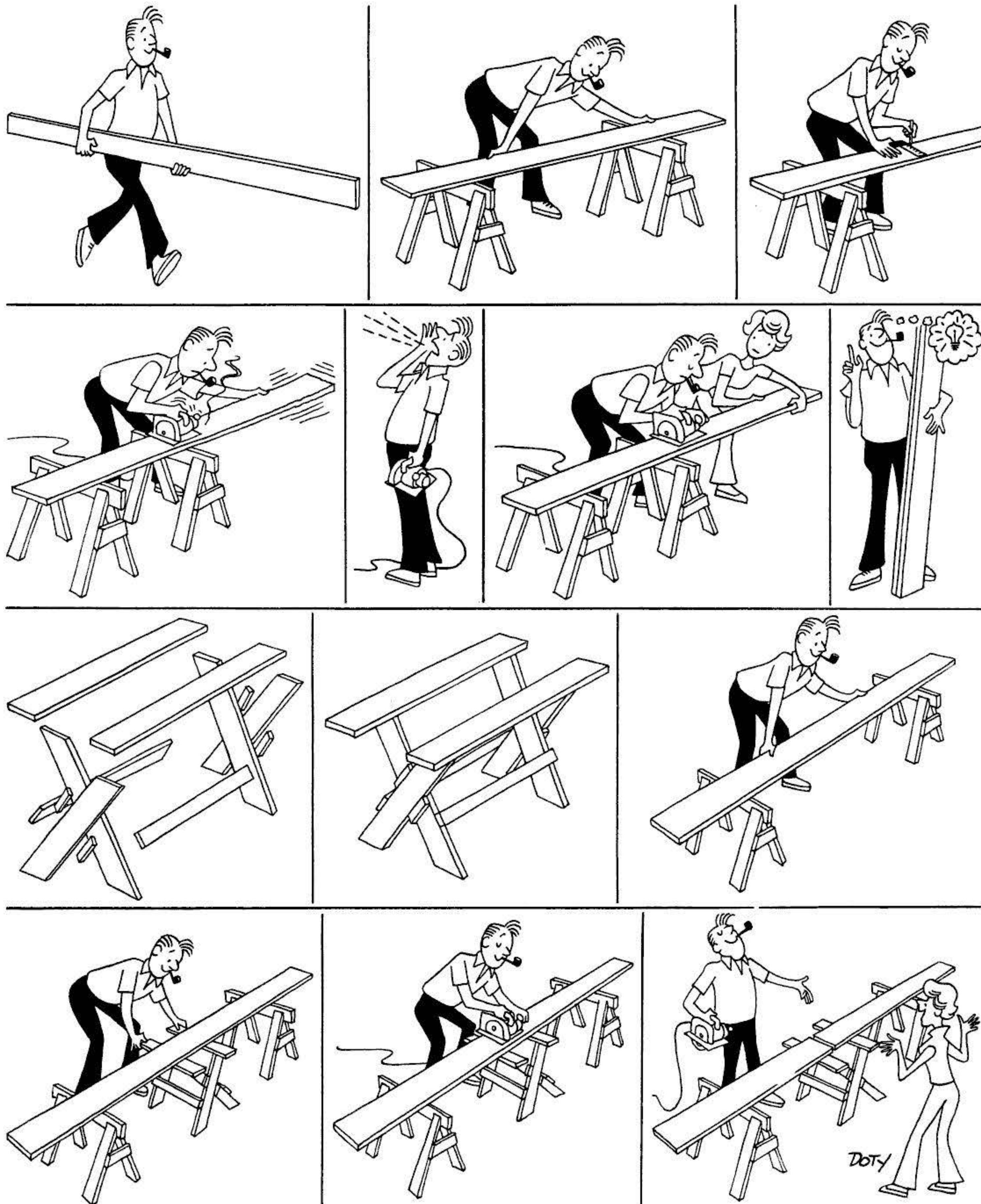
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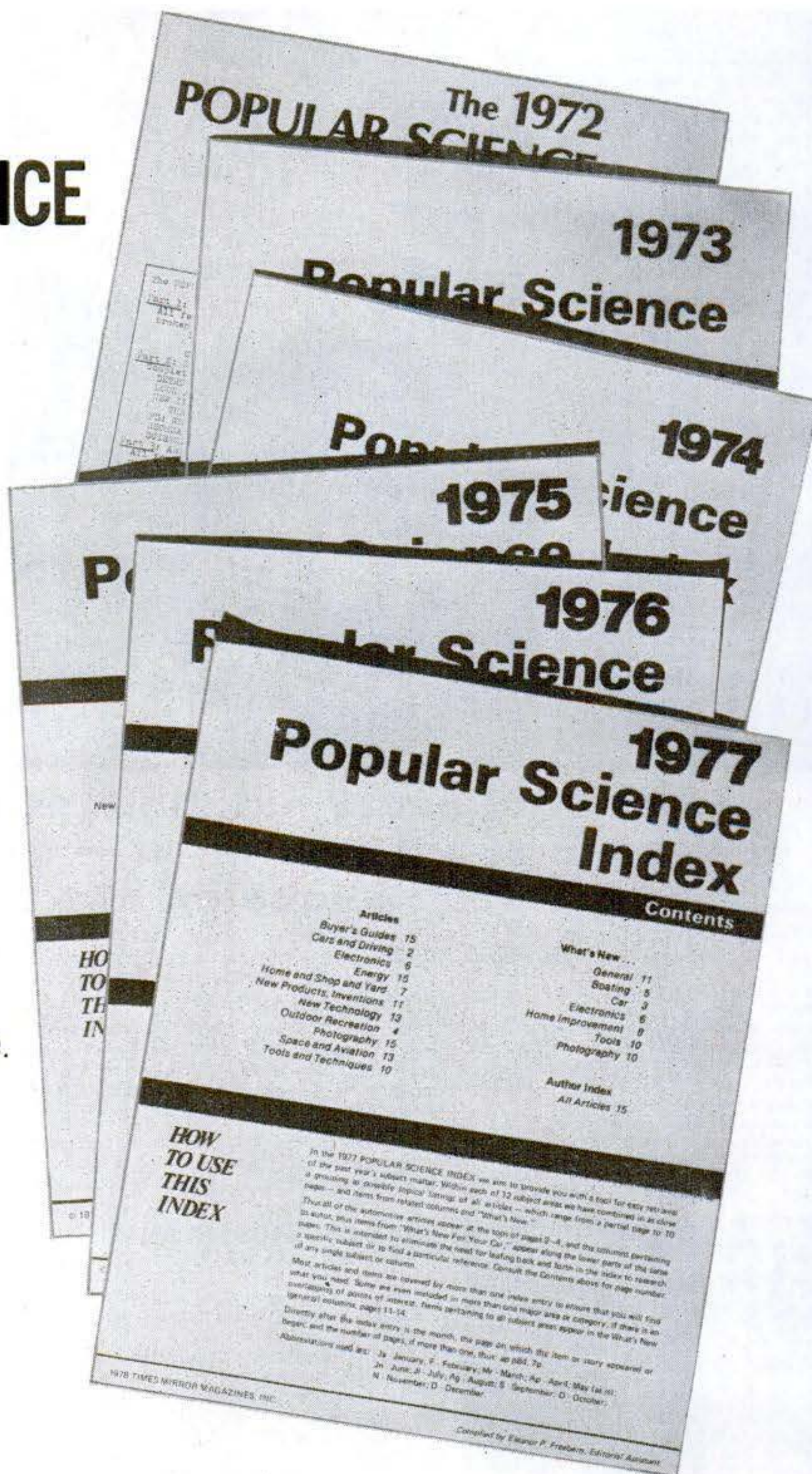
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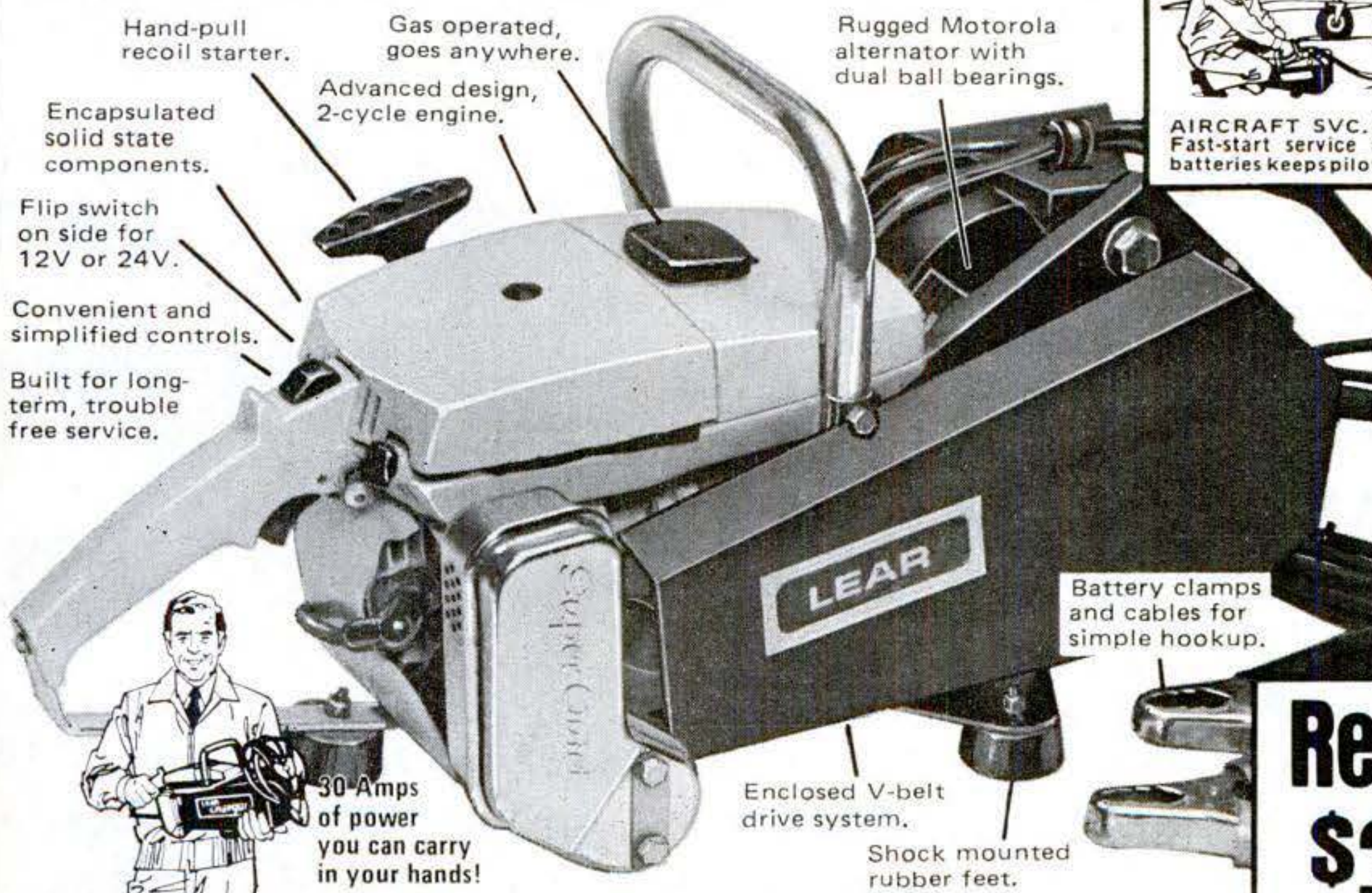
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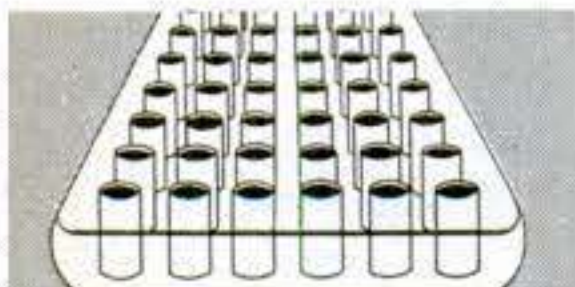
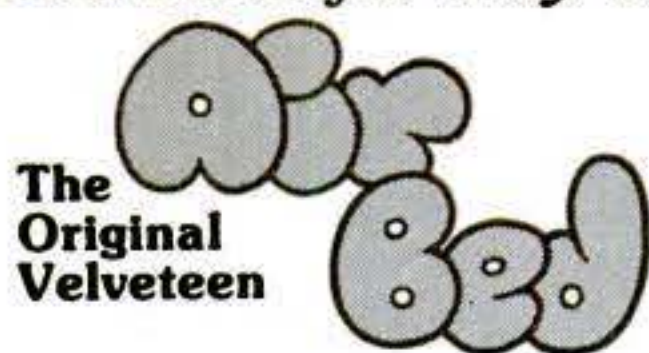
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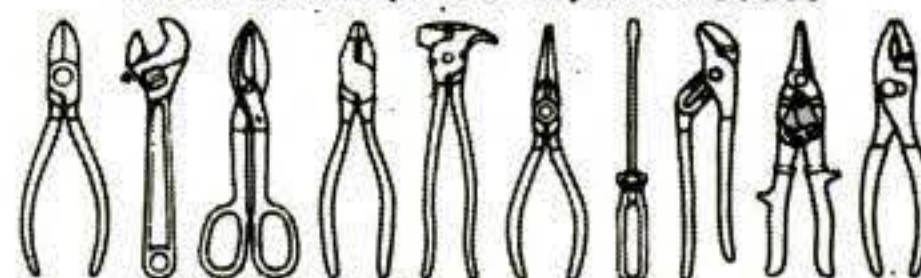
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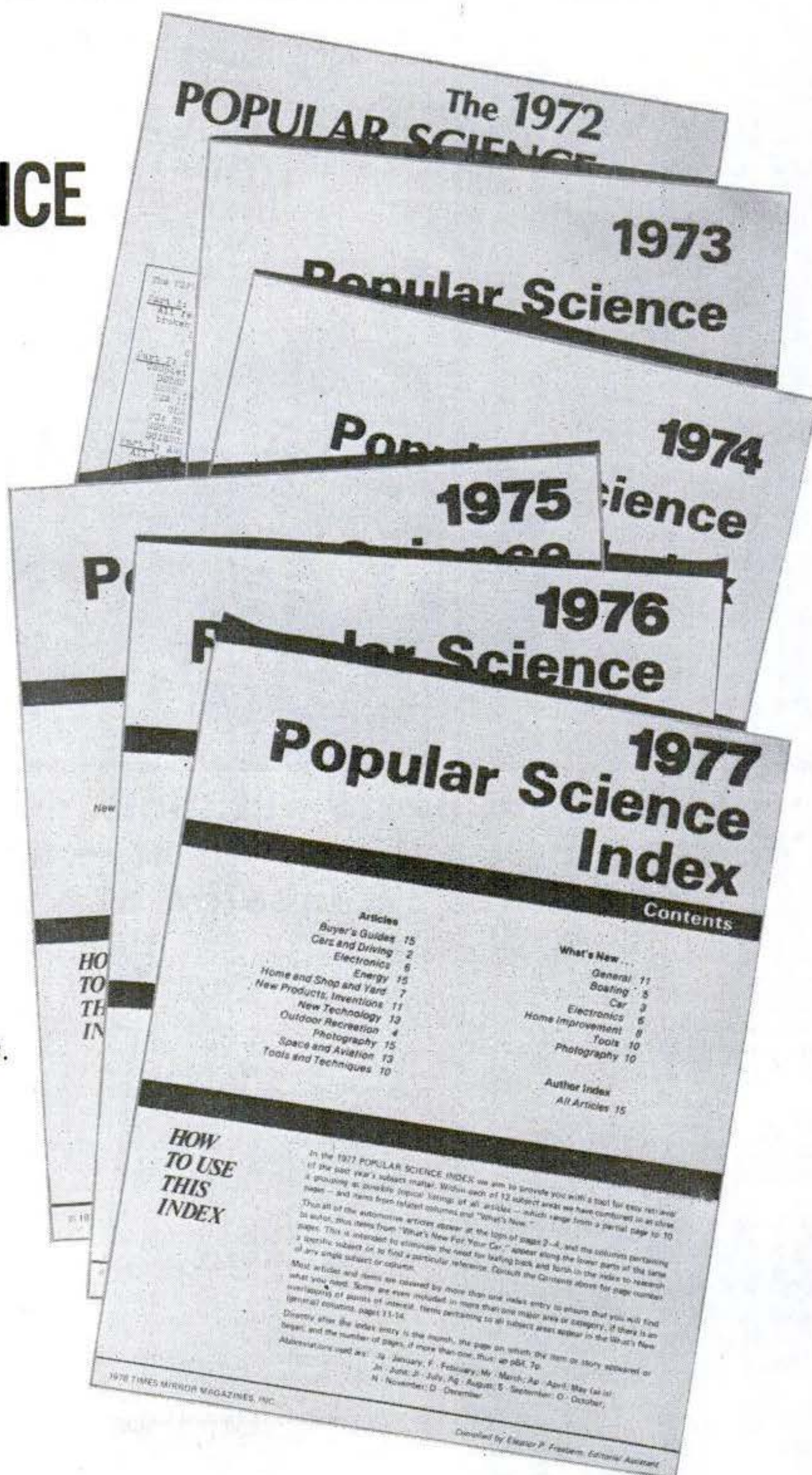
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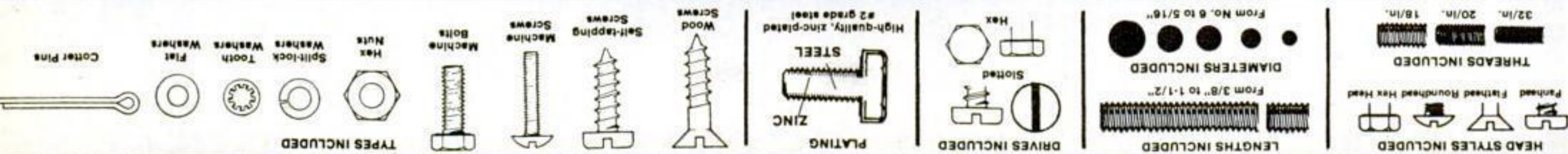
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The Ultimate Tax Shelter



by
TED NICHOLAS

Tax experts are now referring to a small, privately owned corporation as "The Ultimate Tax Shelter." This is especially true since the passage of the Tax Reform Act of 1976. This law makes most former tax shelters either obsolete, or of little advantage. Investments affected include real estate, oil and gas drilling, cattle feeding, movies, etc. These former tax shelters have lost their attractiveness. Aside from that, these tax shelters required a large investment. Only a small segment of the population could benefit from them.

I've written a book showing how you can form your own corporation. I've taken all the mystery out of it. Thousands of people have already used the system for incorporation described in the book. I'll describe how you may obtain it without risk and with a valuable free bonus.

A corporation can be formed by anyone at surprisingly low cost. And the government encourages people to incorporate, which is a little known fact. The government has recognized the important role of small business in our country. Through favorable legislation incorporating a small business, hobby, or sideline is perfectly legal and ethical. There are numerous tax laws favorable to corporate owners. Some of them are remarkable in this age of ever-increasing taxation. Everyone of us needs all the tax shelter we can get!

Here are just a few of the advantages of having my book on incorporating. You can limit your personal liability. All that is at stake is the money you have invested. This amount can be zero to a few hundred or even a few thousand dollars. Your home, furniture, car, savings, or other possessions are not at risk. You can raise capital and still keep control of your business. You can put aside up to 25% of your income tax free. If you desire, you may wish to set up a non-profit corporation or operate a corporation anonymously. You will save from \$300 to \$1,000 simply by using the handy tear-out forms included in the book. All the things you need: certificate of incorporation, minutes, by-laws, etc., including complete instructions.

There are still other advantages. Your own corporation enables you to more easily maintain continuity and facilitate transfer of ownership. Tax free fringe benefits can be arranged. You can set up your health and life insurance and other programs for you and your family wherein they are tax deductible. Another very important option available to you through incorporation is a medical reim-

bursement plan (MRP). Under an MRP, all medical, dental, pharmaceutical expenses for you and your family can become tax deductible to the corporation. An unincorporated person must exclude the first 3% of family's medical expenses from a personal tax return. For an individual earning \$20,000 the first \$600 are not deductible.

Retirement plans, and pension and profit-sharing arrangements can be set up for you with far greater benefits than those available to self-employed individuals.

A word of caution. Incorporating may not be for you right now. However, my book will help you decide whether or not a corporation is for you now or in the future. I review all the advantages and disadvantages in depth. This choice is yours after learning all the options. If you do decide to incorporate, it can be done by mail quickly and within 48 hours. You never have to leave the privacy of your home.

I'll also reveal to you some startling facts. Why lawyers often charge substantial fees for incorporating when often they prefer not to, and why two-thirds of the New York and American Stock Exchange companies incorporate in Delaware.

You may wonder how others have successfully used the book. Not only a small unincorporated business, but enjoyable hobbies, part time businesses, and even existing jobs have been set up as full fledged corporations. You don't have to have a big business going to benefit. In fact, not many people realize some very important facts. There are 30,000 new businesses formed in the U.S. each and every month. 98% of them are small businesses; often just one individual working from home.

To gain all the advantages of incorporating, it doesn't matter where you live, your age, race, or sex. All that counts is your ideas. If you are looking for some new ideas, I believe my book will stimulate you in that area. I do know many small businessmen, housewives, hobbyists, engineers, and lawyers who have acted on the suggestions in my book. A woman who was my former secretary is incorporated. She is now grossing over \$30,000 working from her home by providing a secretarial service to me and other local businesses. She works her own hours and has all the corporate advantages.

I briefly mentioned that you can start with no capital whatsoever. I know it can be done, since I have formed 18 companies of my own, and I began each

one of them with nothing. Beginning at age 22, I incorporated my first company which was a candy manufacturing concern. Without credit or experience, I raised \$96,000. From that starting point grew a chain of 30 stores. I'm proud of the fact that at age 29 I was selected by a group of businessmen as one of the outstanding businessmen in the nation. As a result of this award, I received an invitation to personally meet with the President of the United States.

I wrote my book, *How To Form Your Own Corporation Without A Lawyer For Under \$50*, because I felt that many more people than otherwise would could become the President of their own corporations. As it has turned out, a very high proportion of all the corporations formed in America each month, at the present time are using my book to incorporate.

Just picture yourself in the position of President of your own corporation. My book gives you all the information you need to make your decision. Let me help you make your business dreams come true.

As a bonus for ordering my book now, I'll send you absolutely free a portfolio of valuable information. It's called "The Incom Plan" and normally sells for \$9.95. It describes a unique plan that shows you how to convert most any job into your own corporation. You'll increase your take-home pay by up to 25% without an increase in salary or even changing jobs in many cases. If you are an employer, learn how to operate your business with independent contractors rather than employees. This means that you'll have no payroll records or withholding taxes to worry about. And you'll be complying with all I.R.S. guidelines. "The Incom Plan" includes forms, examples and sample letter agreements to make it possible.

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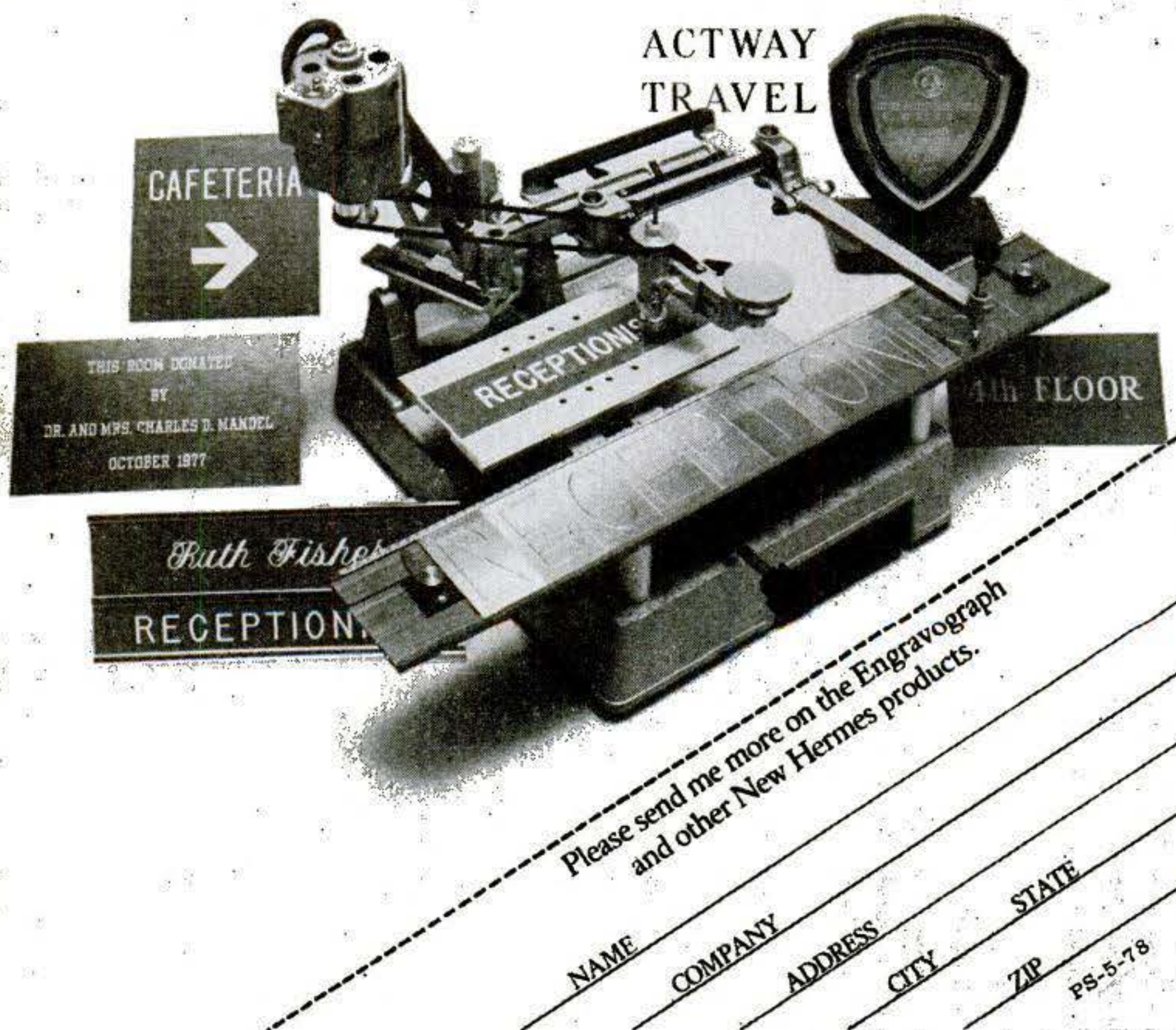
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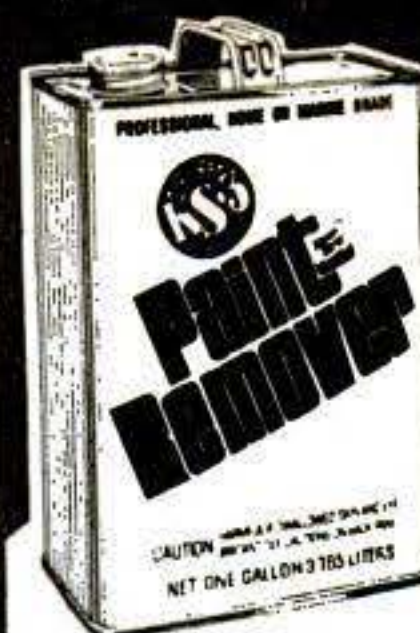
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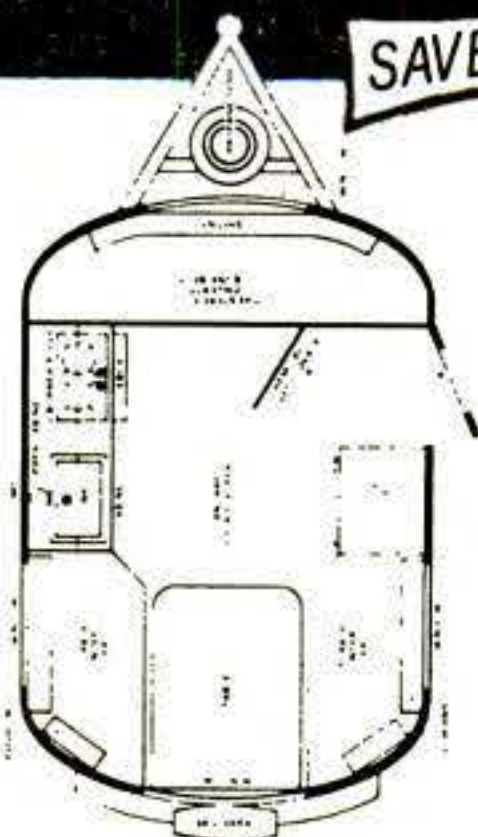
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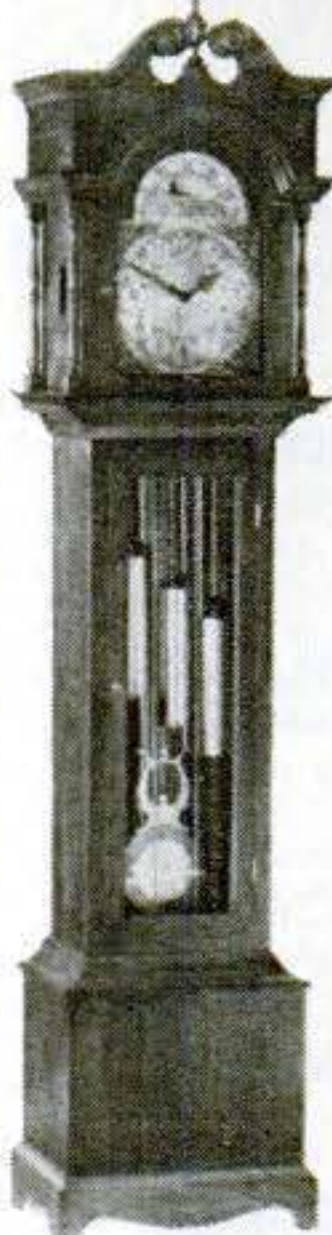
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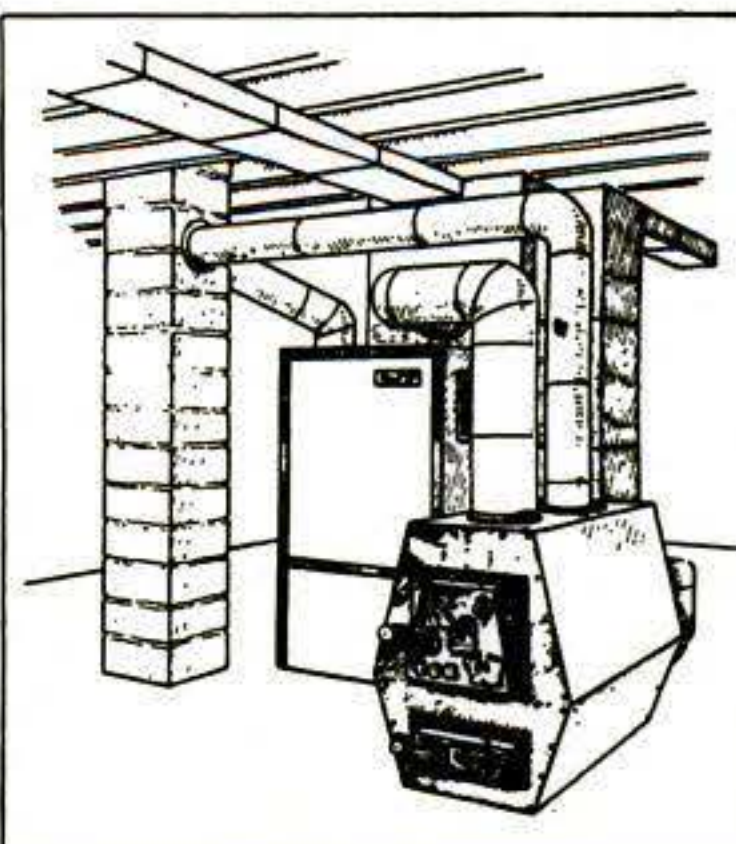
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The SUNWATCH... Acclaimed As The Most Accurate, Most Versatile, Most Rugged Watch Ever Made.

These Exclusive Features Make All Other Watches Obsolete...

- Clearly Visible by Day or Night
- Unique Side-Window View, Simplifies Reading
- 100% SUN-POWERED, No Batteries That Need Replacing
- No Need Ever To Reset the Built-In Calendar — Not Even in 31-Day Months and Leap Years!

Solar Age Efficiency — Space Age Styling...

The SUNWATCH puts an end to all the difficulties other watches create. You'll never worry about accuracy again. With this precision timepiece you'll always be secure, knowing that for the rest of your life you'll be on time...almost to the second! Also, there will be no more pushing buttons to tell the time, and no straining your eyes to read the numbers in bright sun or dark rooms.

After more than 10 years of very extensive and costly research, Roger Riehl, noted expert in solar energy, integrated circuitry, and computer chip technology, has developed the beautiful High-Performance SUNWATCH, which is now the most advanced watch available for sale to the public.

The Fascinating Technological Story...

Because of an Exclusive and Important Calibration Breakthrough, the SUNWATCH is the FIRST WATCH IN HISTORY THAT IS ACCURATE TO 1 SECOND PER MONTH! (That's 5 Times Better Than The Latest Quartz Accutron).

Tiny Silicon Power Cells are the incredible Power Source; they're constantly being energized from natural Sunlight, Daylight, or an Ordinary Light Bulb while you're wearing your watch.

Also, a Specialized Micro Circuit Computer has been electronically programmed to display the correct month and day with NO resetting for the next 123 years!

• **Natural Side-View Window** lets you tell the time, day, and date without twisting your arm into an obvious, awkward position.

• **Four Varying Light Intensities** built into the viewing window, which automatically adjusts to the available light. Numbers are CLEARLY VISIBLE in Bright Sun or Pitch Black.

• **Exclusive "C/MOS Brain" Computer-On-A-Chip** displays the correct month and date, PLUS it automatically adjusts the watch calendar for long and short months AND Leap Year until 2100 A.D.!

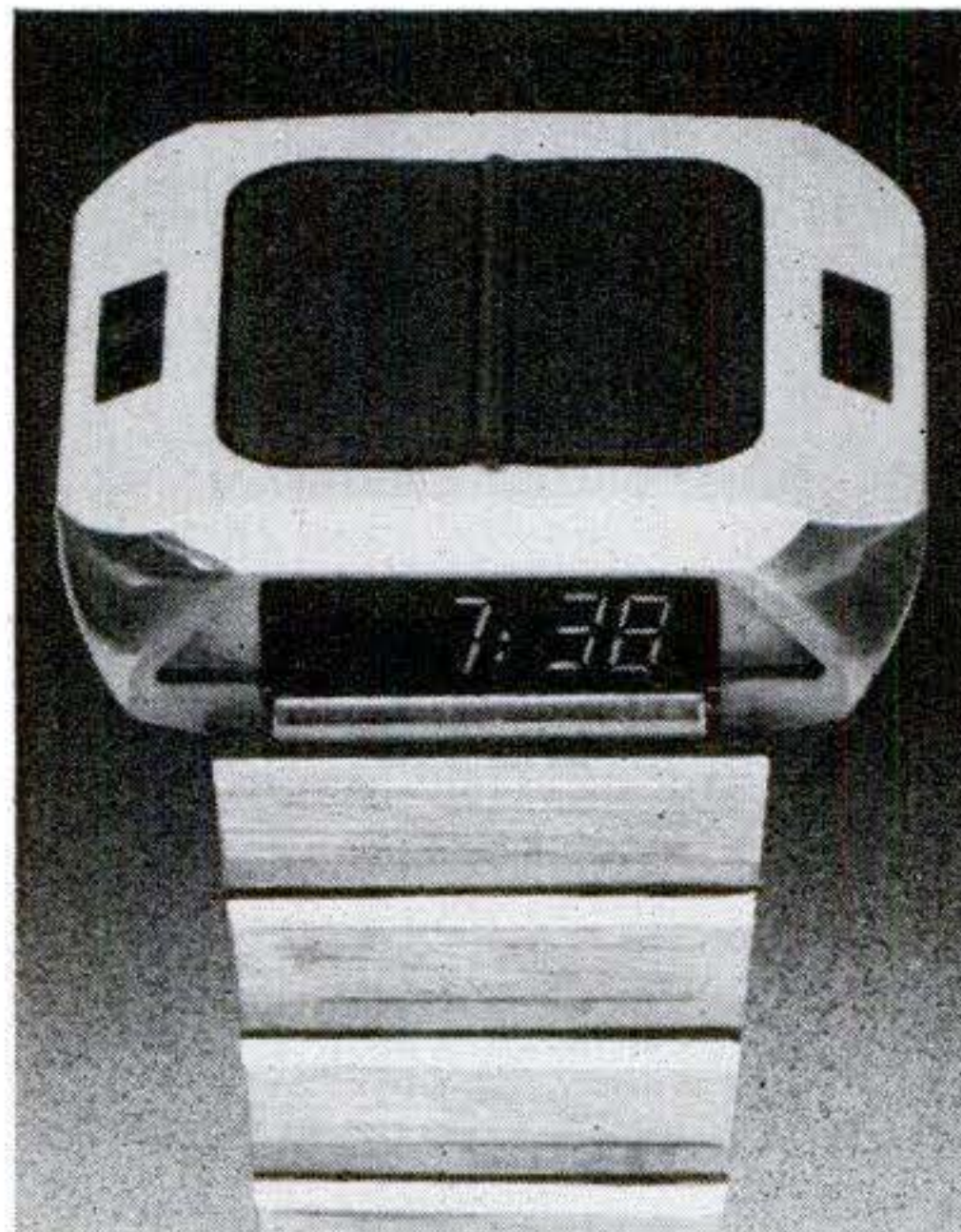
• **Continuous Seconds Display** — Useful for Pulse-taking, Stopwatch timing, etc.

• **Miniature Solar Cells** are automatically charged by sunlight, daylight, even ordinary light bulbs — they last virtually forever. You never need to replace batteries. This advanced Power Storage System is of the same type installed in Communication Satellites.

• **Magnetically Operated Slide Bars** activate SUNWATCH's many functions, including hours, minutes, seconds, day, date, month, speed control, seconds countoff, leap year.

• **Permanently Sealed Lexan Module**, protected by U.S. and Foreign Patents until 1992, encapsulates all energy cells, solar panels, quartz crystal, Computer-On-A-Chip, Readouts, etc. This makes SUNWATCH the MOST INDESTRUCTIBLE WATCH EVER!

• **Completely Waterproof** (You Can Safely Suspend It In Boiling Water for 30 Minutes!)



• **Shock Resistant to 5000 G's** (Crash It Into a Rug-Surfaced Brick Wall at 90 mph without noticeable effect!)

• **Temperature and Pressure Resistant** (Freeze SUNWATCH in a block of ice for a year or Wear in Water 750 FEET DEEP without damage.)

As you have read, SUNWATCH is truly the most revolutionary, the most remarkable watch ever made. Virtually a Perpetual Time Machine, Years ahead of the usual replaceable batteries, jewels, and tuning forks. *You must see it for yourself and you can do so at no risk whatsoever:*

WE ARE MOST IMPRESSED WITH THIS INCREDIBLE SOLAR TIMEPIECE, AND WE'VE SEEN HOW POSITIVE OUR CUSTOMERS HAVE REACTED TO OWNING AND WEARING IT, therefore we are making this offer available to the readers of this publication. TRY THE SUNWATCH AT OUR RISK. Then, if you decide to keep it, Save \$69.05!

SUNWATCH sells in selected stores for \$199.00 But you can wear it at our risk for 15 days, then, if you're not completely satisfied, return it for full money back. No questions will be asked, and your refund will be sent out to you immediately!

The Exciting SUNWATCH offers Split-Second Accuracy based on Solar Energy and Advanced Design Features, all packaged in a striking, contemporary styled Timepiece that is Virtually Indestructible even under the most severe conditions. The Perfect Watch of a lifetime for Business People, Professionals, Teachers, Athletes, etc.

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At your request, each watch will be hand-engraved with your name (or any name you specify) to label and personalize it yours for a lifetime.)

Limited Warranty is YOUR Protection

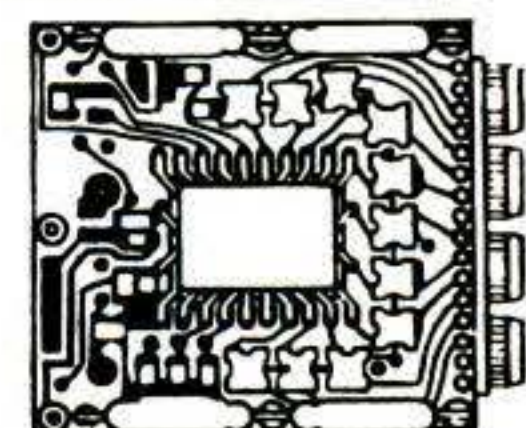
The Sun Watch is covered by a 2 year limited warranty issued by Riehl Time Corporation (Manufacturer of the Synchronar 2100), and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Starshine Group, 924 Anacapa St., Santa Barbara, Calif. 93101. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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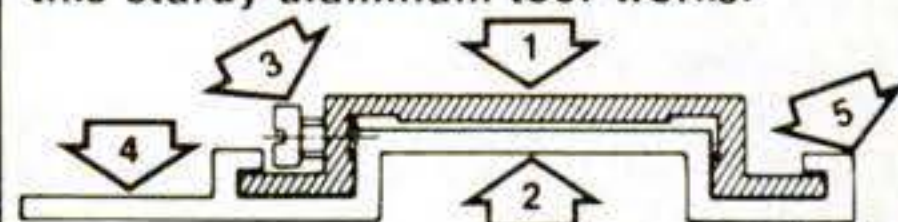
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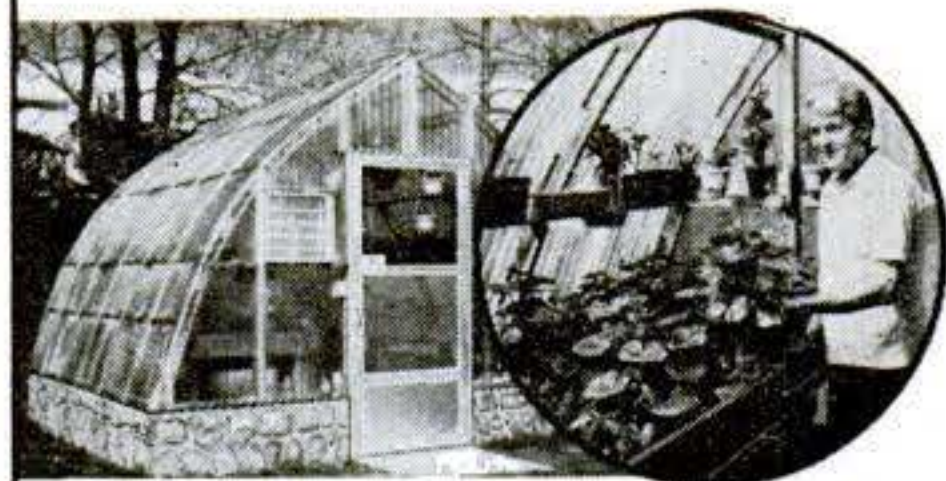


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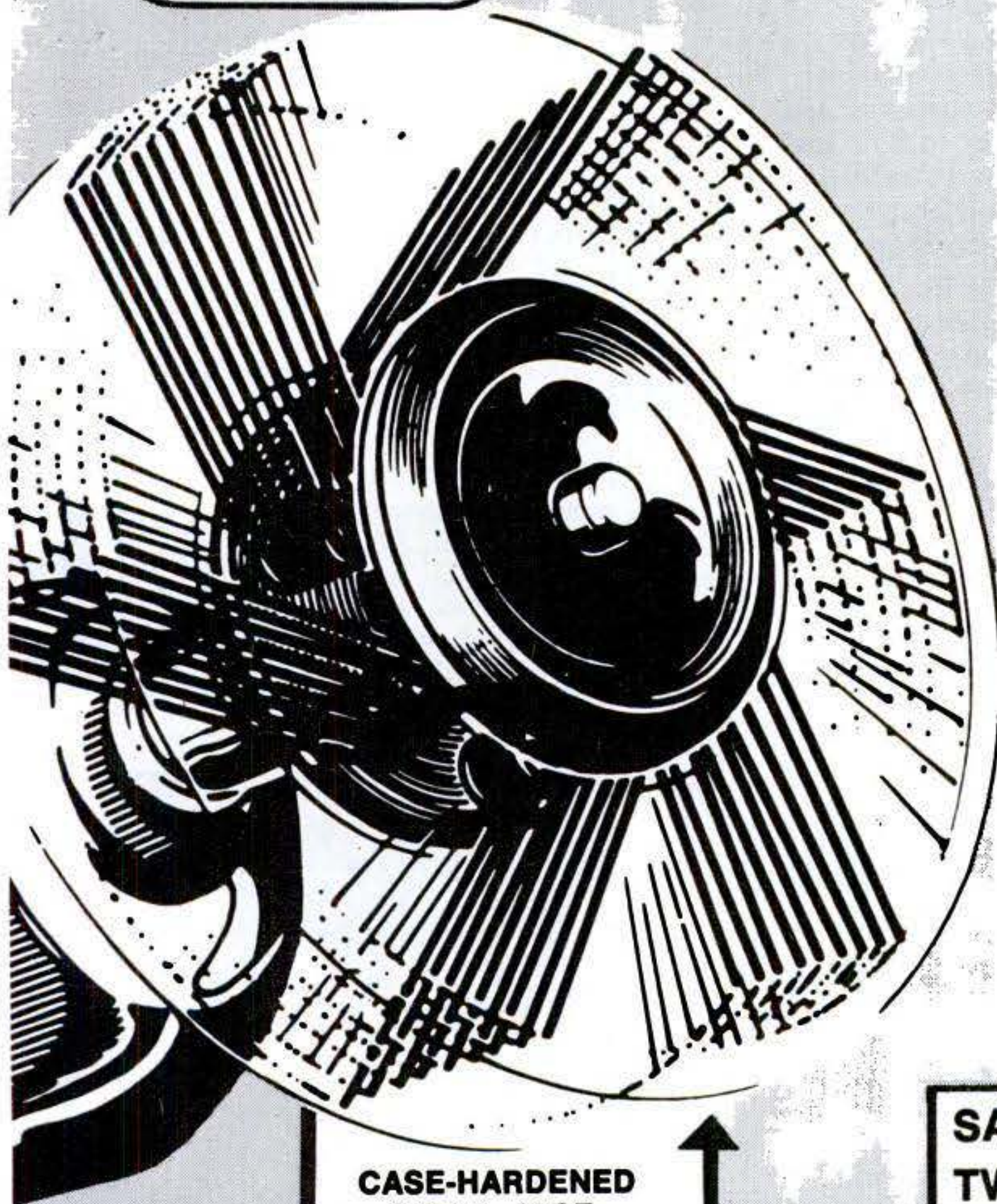
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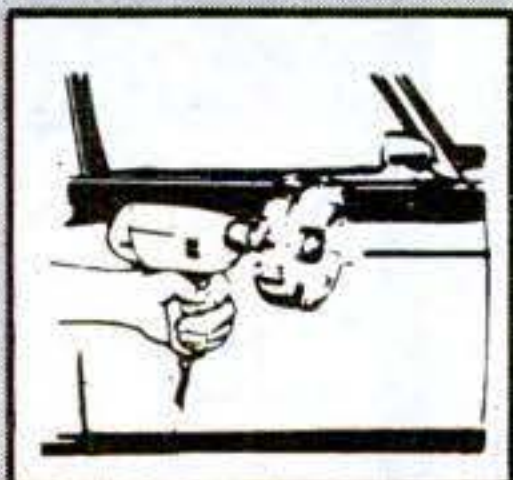
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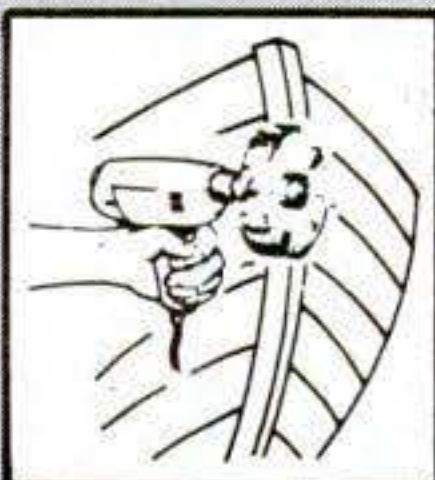
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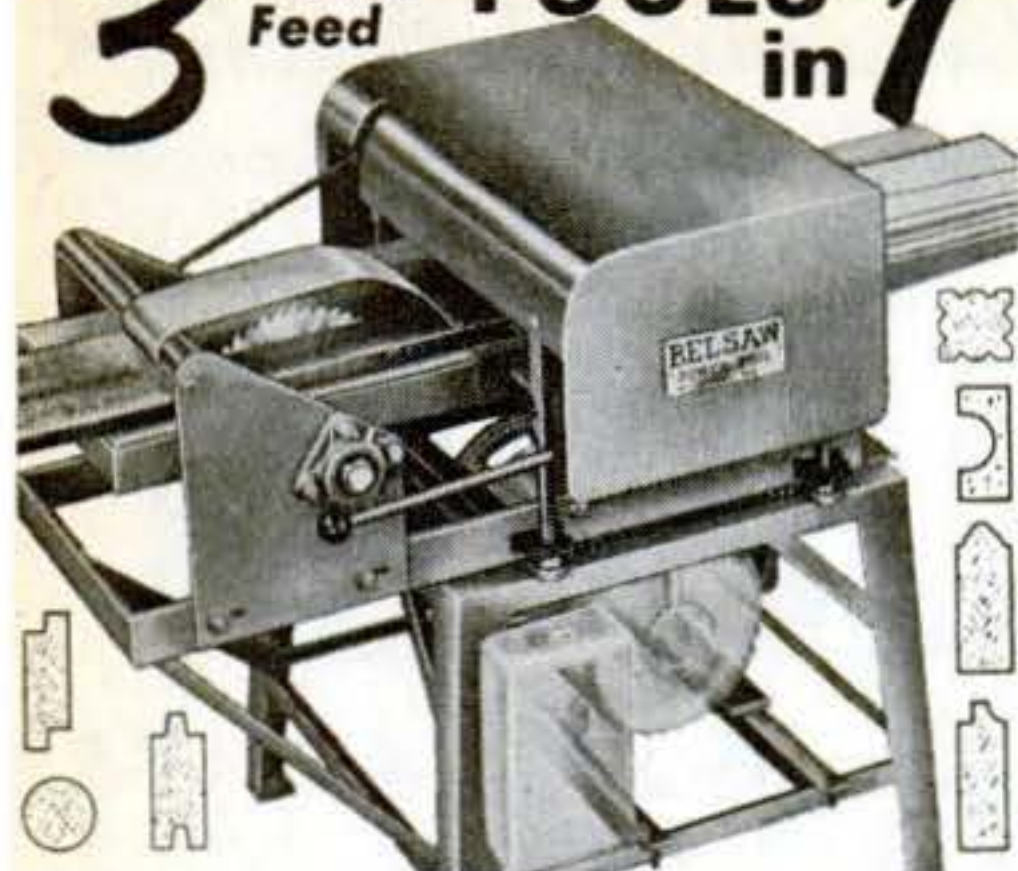
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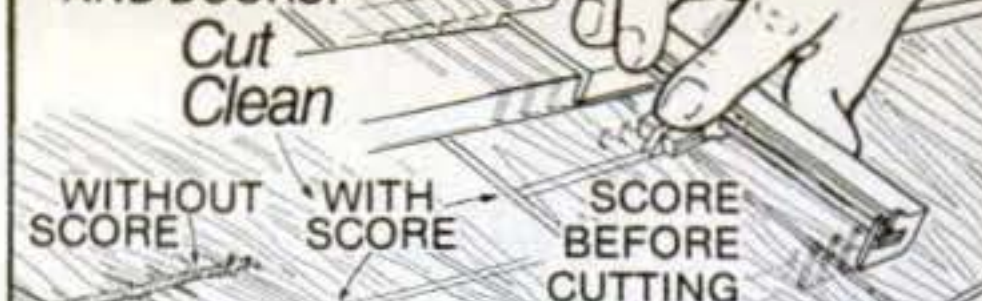
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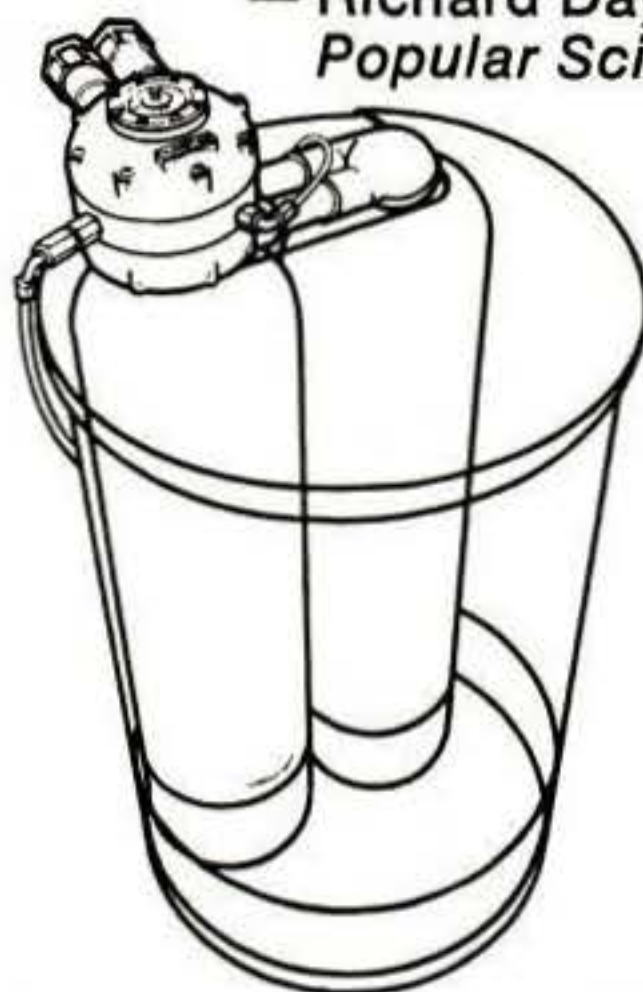
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**WAISTLINES SHRINK UP TO 3 INCHES
IN 7 DAYS — A FULL 5 INCHES
SMALLER IN A SINGLE MONTH!**

Case History #2: When first rumors of this

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**DOCTORS REPORT: AVERAGE LOSS —
57 POUNDS!**

Case History #3: But most significant of all . . . when universities, hospitals and medical schools, (such as New York's Leading Medical School and Cleveland's largest hospital) tested this newly discovered "crash-loss program" on patients who all their lives had been hopelessly overweight . . . they reported astonishing losses of as much as 2 pounds a day at the start . . . 20 to 30 pounds a month . . . as much as 70 pounds lost over a single summer season! — by simply stepping up their fat-burning metabolism and burning, melting, oxidizing 50, 70, 100 pounds of hard-set fat . . . FASTER, SURER than they had ever dreamed possible!

**WORKS LIKE "POWDERED HEAT" —
MAKES YOUR INNER FURNACE BREAK
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What is this wondrous new development that helps safely stimulate fat-burning metabolism and shrink your body's fat cells the moment it starts working in your system? It is a totally new concept in the war against fat. An ANTI-FAT WEAPON unlike anything you've ever seen, or tried in your life. A FAT-BURNING aid that helps you convert body fat to body fuel AUTOMATICALLY . . . and EVAPORATE excess pounds and inches starting the very first day!

Think of it! A medically proven formula that is such an effective reducing aid . . . that when combined with the food you eat on this "crash-loss" program . . . burns off as much fat each 24 hours as if you jogged up to 14 miles a day . . . or played 3 hours of tennis in the most brutal heat!

The name of this wondrous amino formula is "THERA-SLIM-100" and here is precisely how you use it to win the body and figure of your dreams as you:

**LOSE UP TO 4 TO 6 INCHES OFF YOUR
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LOSE UP TO 3 INCHES OFF YOUR
THIGHS
LOSE UP TO 4 INCHES OFF YOUR
BUTTOCKS
LOSE UP TO 4 INCHES OFF YOUR
STOMACH**

and as we've said before, starting not in weeks, but in mere days.

**HELPS YOUR BODY CONVERT STORED UP
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GIANT STEP into a whole new world of LIFE-TIME SLIMNESS.

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In addition to the wide and tasty selection of food you enjoy morning and night, (all scientifically programmed to help maintain a high-level of FAT BURN-OFF) . . .

**STEP #2 — YOU
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Once a day, you take "THERA-SLIM-100" in a glass of water, (just like refreshing fruit juice). This hi-amino intake helps keep the fat-burning chain-reaction going ALL 24 HOURS OF THE DAY — NON STOP!

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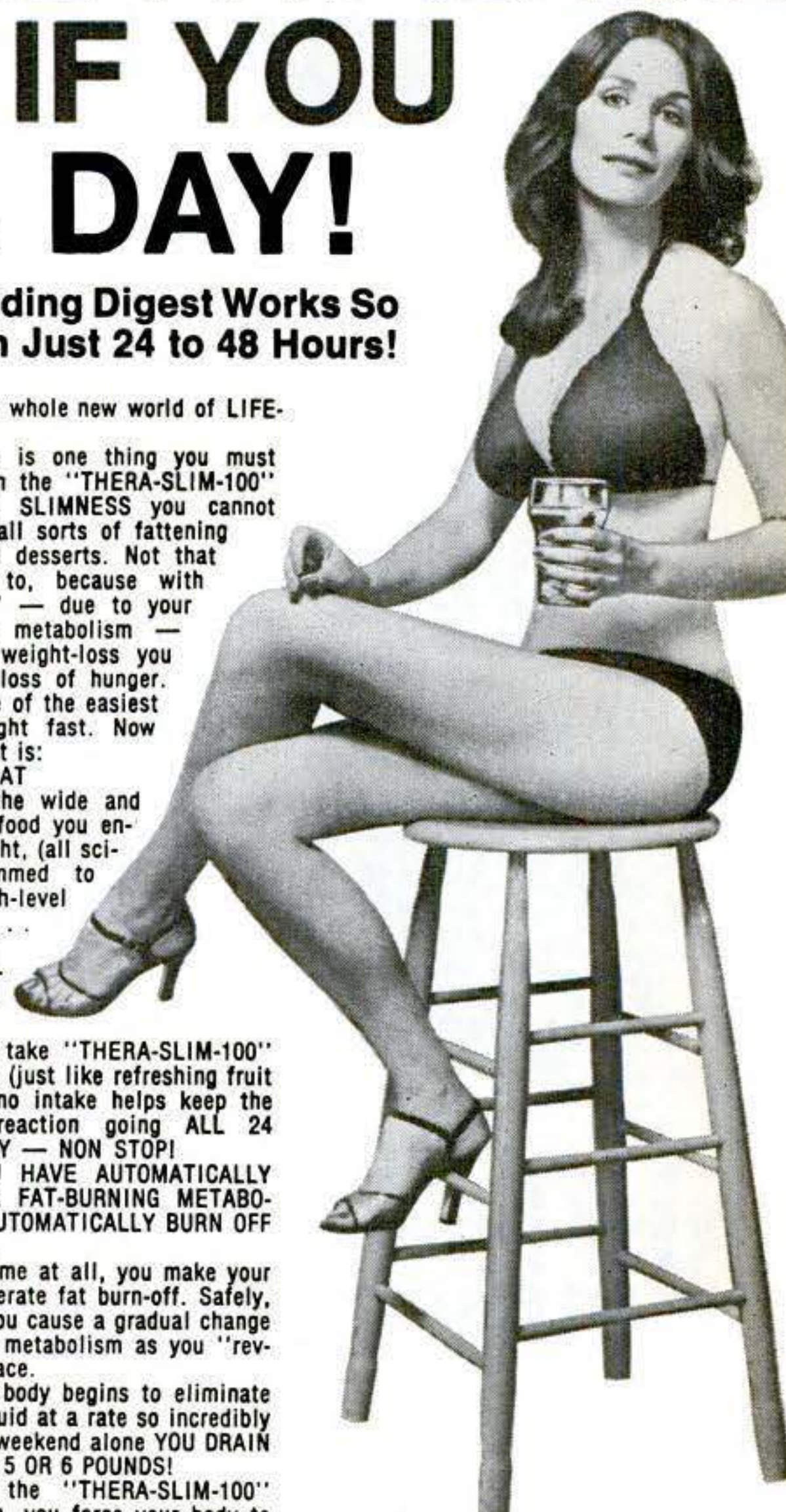
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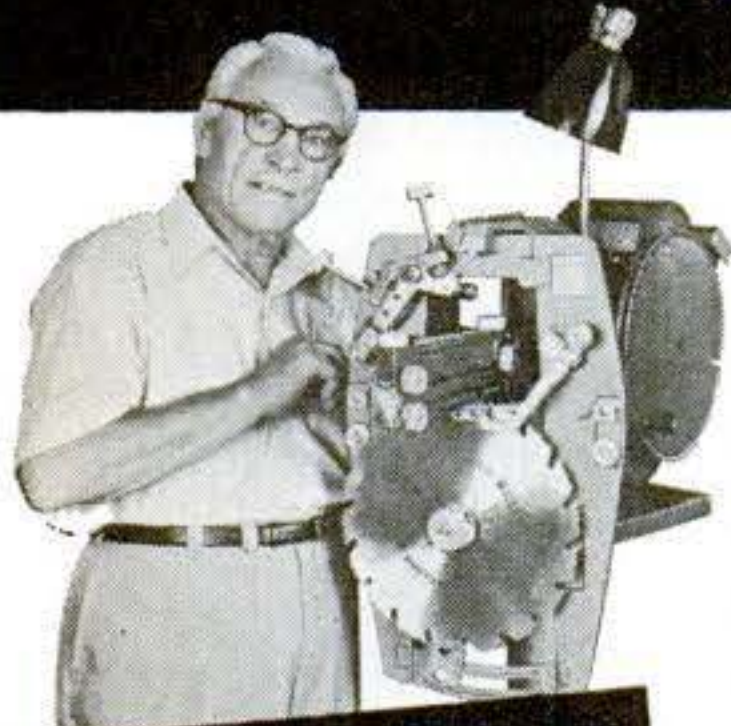
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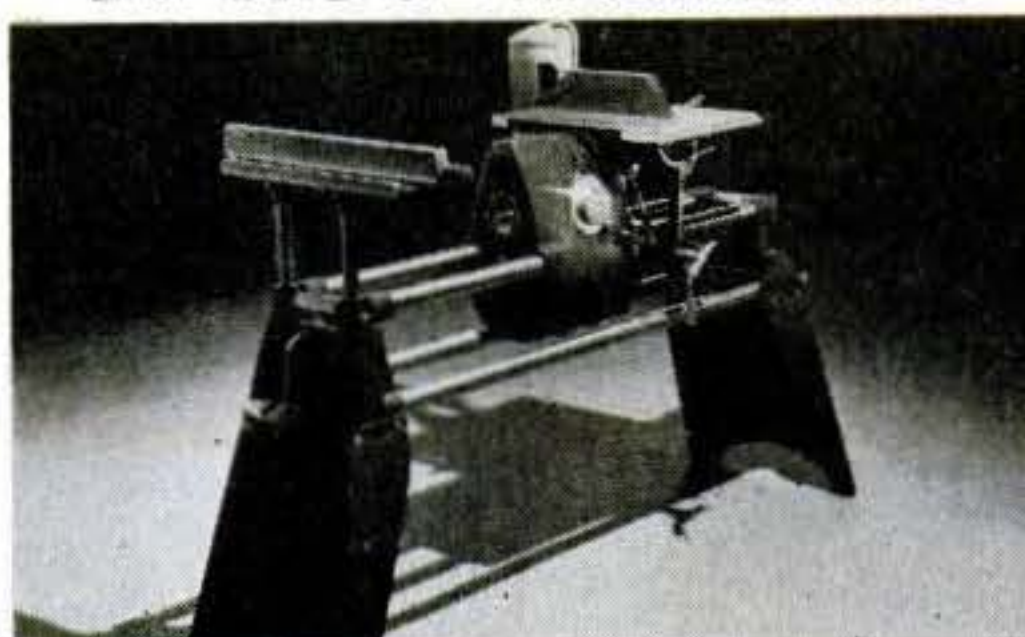
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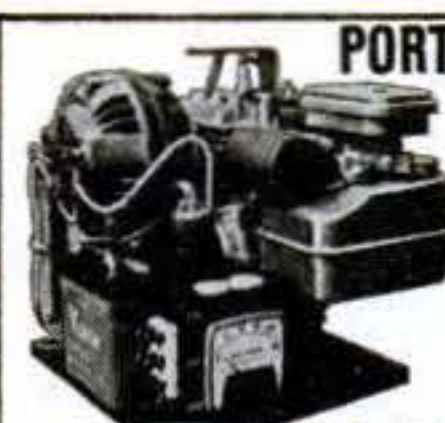
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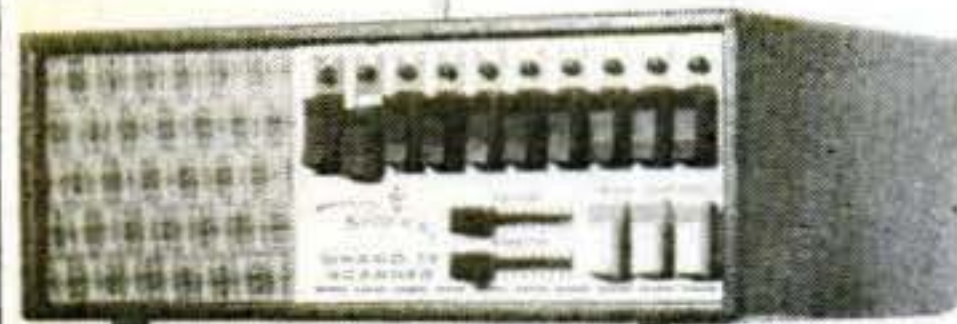
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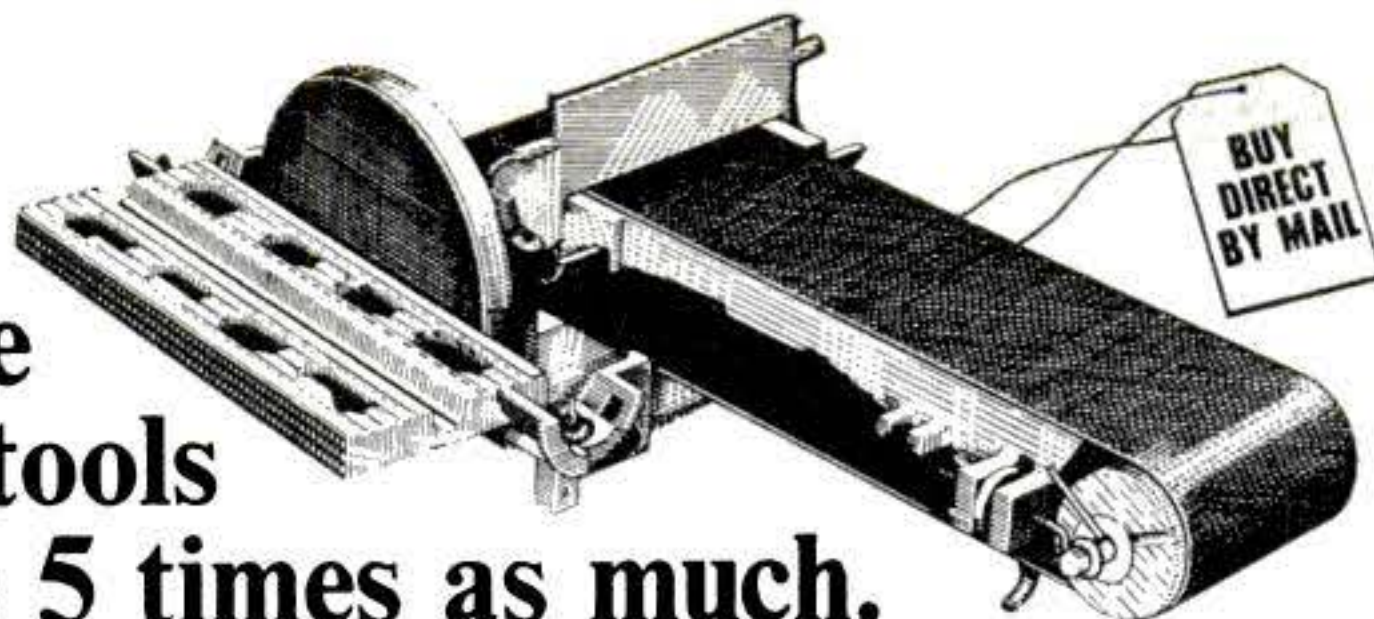


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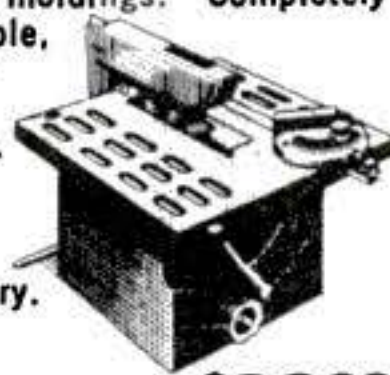
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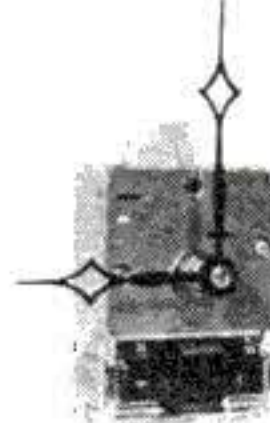
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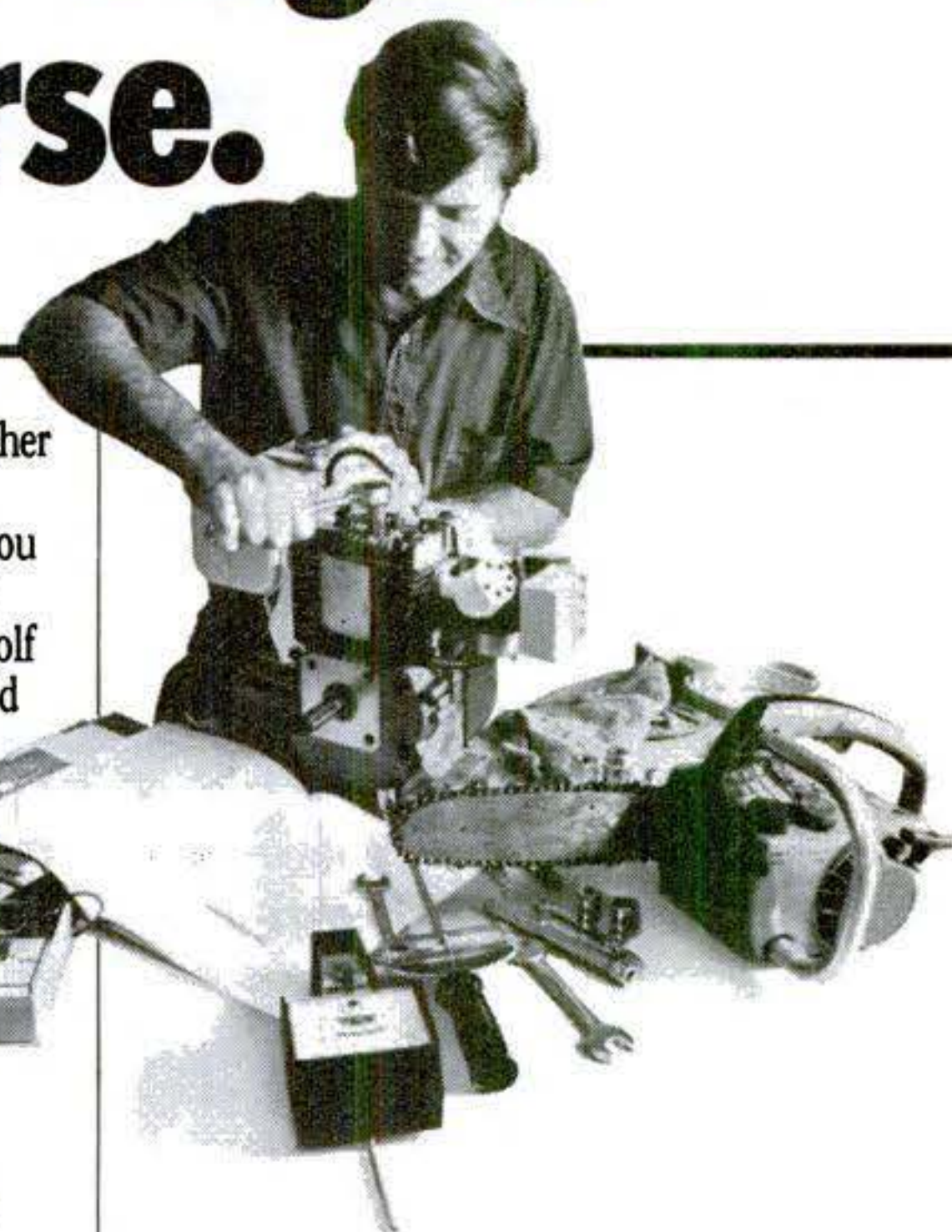
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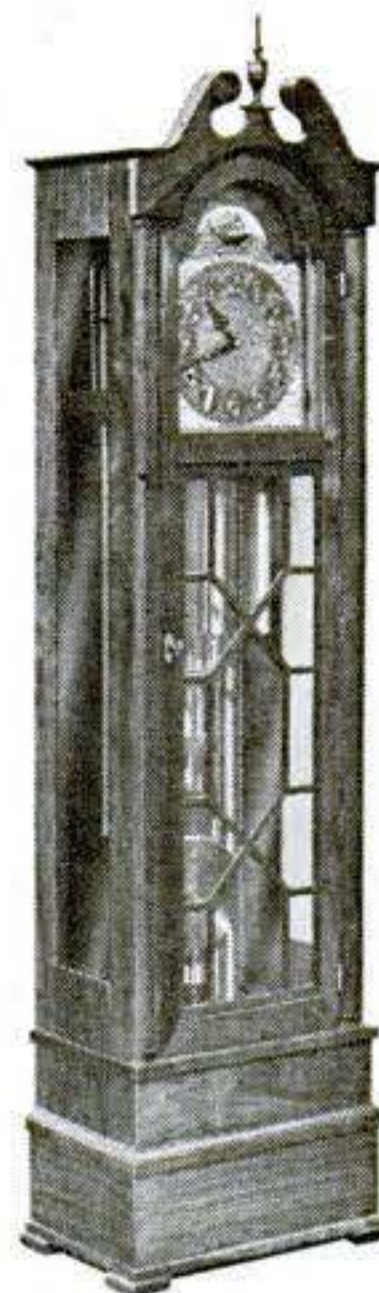
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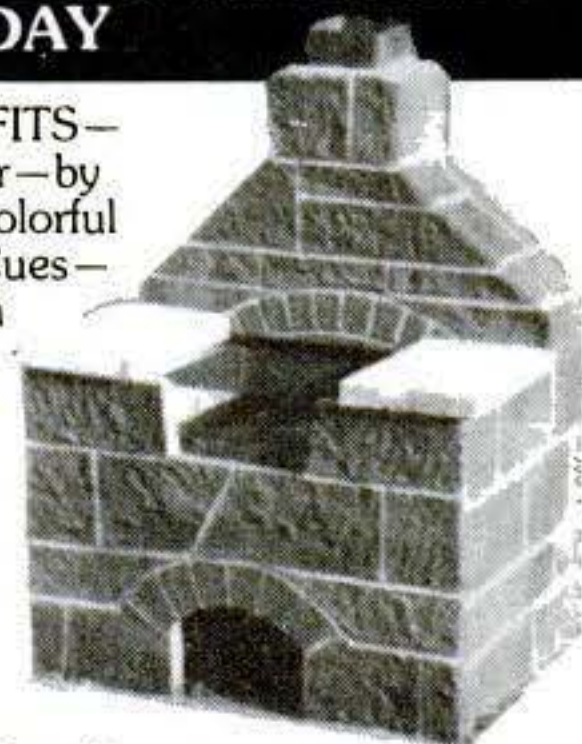
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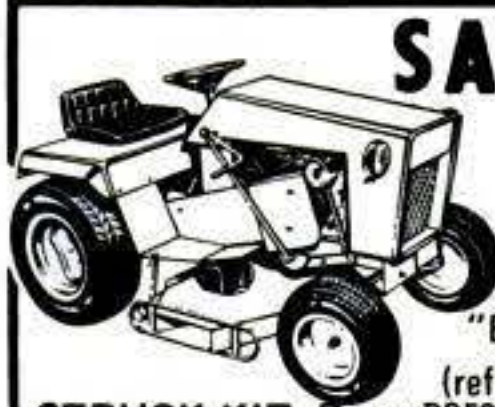
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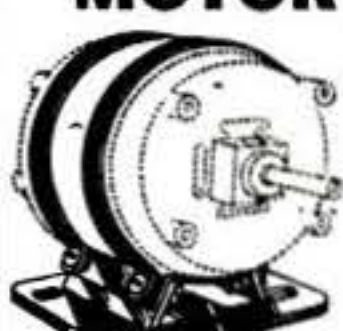
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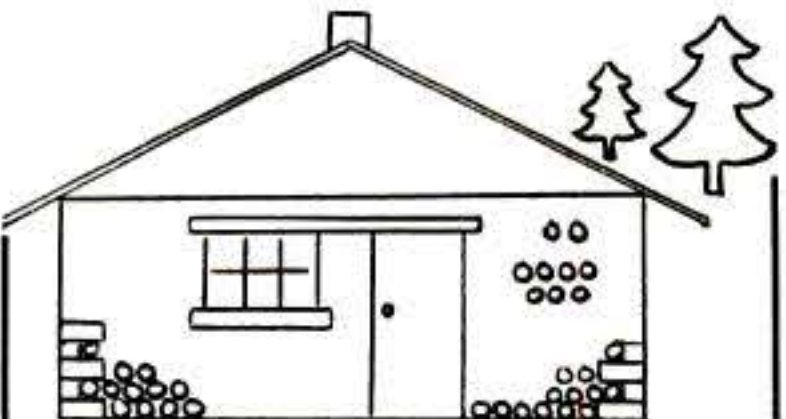
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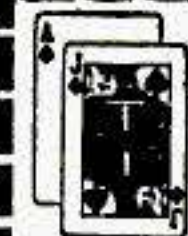
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